THE PROCESS OF TECHNICAL CHANGE IN AGRICULTURE: THE CASE OF THE SAGA PLAIN AREA OF JAPAN, 1868 - 1939

by

PENELOPE GILLIAN FRANCKS

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SCHOOL OF ORIENTAL AND AFRICAN STUDIES

UNIVERSITY OF LONDON

ABSTRACT

This thesis analyses the micro-economic process of technical change in one particularly successful agricultural area of Japan, the Saga Plain, between 1868 and 1939. It does so within a framework which relates the characteristics of the new techniques selected to the prevailing technical, economic and social environment, through the institutional mechanisms for the development of new technology. These characteristics themselves then influence the diffusion of new techniques and their effects.

The Saga Plain differs from much of the rest of Japan in its natural environment. Hence the technology employed in paddy rice cultivation at the beginning of the period also differed, especially in methods of irrigation. Economic and social relationships between households centered on arrangements to meet the heavy labour and capital requirements of the irrigation technology and to ensure the subsistence of cultivators. The technical and economic system was disrupted by the rapid industrialisation of nearby areas after 1900. This raised the demand for marketed rice and caused a substantial outflow of small-scale cultivators. Shortage of hired labour forced larger cultivators to split up their holdings, and the proportion of middle-sized cultivators increased. Such farmers were under pressure to find ways of lessening the labour requirements for irrigation and raising output.

The solution to their problems was developed by local government and extension officials, who assisted the manufacturers in the design of an electric pump. This innovation was rapidly diffused through communal purchase of the pumps by village organisations. It was the breakthrough which permitted the adoption of other new techniques, leading to substantial rises in yields and labour productivity. It intensified the trend towards increasing proportions of medium-scale family farms. The study suggests conclusions as to the institutional requirements for the development of appropriate techniques and the relationship between technical and structural change in agriculture.

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CONVENTIONS

Romanisation.

Japanese words are romanised according to the Hepburn System, but using double letters to indicate long vowel sounds. Exceptions are made where a different romanised form is very familiar to English readers, e.g. Tokyo is used instead of Tookyoo.

Measurements.

Japanese measurements have been converted into their metric equivalents. The Japanese area measure, the choo (= 10 tan), is almost exactly equal to a hectare. One koku of rice is equivalent to 150 kilograms. Figures for yields originally calculated in koku per tan are therefore converted into kilograms per 10 ares (10 ares = 0.1 hectares).

Dates.

Western dates are given throughout, but occasionally Japanese era names are used, following the practice of Japanese writers, to denote periods of time. The Tokugawa period lasted from 1603 until 1867, and the Meiji period from 1868 (the Meiji Restoration) until 1912.

References.

Works set out in the bibliography are indicated in the text and footnotes by the author's name, followed by a number showing position in the bibliography list.

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CHAPTER 1

Introduction and Framework

This study is an analysis of a particular process of technological change in agriculture. Its aim is to use the knowledge gained by Japanese agricultural historians and economists to try to improve our understanding of technological change and its relationship with the agricultural economy. It is hardly necessary to point out the significance of this issue in the light of the potential for advance in agricultural techniques which has arisen in recent years and the successful realisation of this potential in some areas of the developing world. Its significance is enhanced, however, by the fact that the discovery of this potential would seem to have generated almost as many problems as it has solved (Falcon,52). In particular, it has revealed our ignorance of the ways in which the development and diffusion of improvements in techniques are related to, and in turn affect, the economic characteristics and institutional structure of the agricultural society in which they take place. Considerable concern has arisen, for instance, over the effects of technical change on the distribution of income and wealth in rural areas, and the possible social tensions which may arise from this. This gives rise to the hope that further studies of cases of technical change may contribute to improving our understanding of the processes involved and hence our ability to deal with the problems created.

The particular relevence of studies of this process in Japan lies in the fact that Japan is frequently cited as an example of a successful case of agricultural development, in terms both of agriculture's positive contribution to output growth and overall economic development, and of the relative social and institutional stability of the Japanese agricultural sector (1). It is not the purpose of this study to examine the overall validity of this view of agriculture's role in Japanese development, but rather to take one particular successful case of technical change and output growth within the Japanese context and examine how it occurred.

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(1) See, for example, Ohkawa and Rosovsky, 66, and Johnston, 61. For further discussion of agricultural development in Japan as a whole, see Chapter 2.

In this chapter I shall set out the framework I have used in assembling and analysing the available information about the particular case in question. But it is important, first, to describe the issues and problems to which the study is relevant, since the framework is designed to show how the particular case relates to them. They can be summarised broadly in the form of two questions, the first more particular, and the second more general and to some extent subsuming the first:

1. How are the characteristics of newly-developed techniques determined in the case of a successful process of innovation?

2. How is technical change related to the processes of economic, social and institutional change?

Approaches to the first question begin from the now generally accepted assumption that the forces which determine the rate and direction of technical change cannot be regarded to any great extent as exogenous to the economic system in which the change takes place, and that therefore economic analysis is relevant to the study of the process. It follows from this assumption that we must be assuming that new techniques can be produced by the investment of resources in research activity. The rate of technical change will therefore be influenced by the size of the resources invested in research activities. The economic determinants of this investment allocation have been the subject of study by a number of economists but the present micro-level case study is not of particular relevance to this discussion, especially as the research in question was publicly financed. The more relevant issue in the present case is what determines the nature or economic characteristics of the new techniques produced by investment in research activities.

A common answer to this question is that the most significant determinant is changes in relative factor supplies and prices. The idea that firms will direct their research towards developing techniques which economise on relatively expensive factors was originally suggested by Hicks and has subsequently led to much theoretical discussion and argument. The most complete working out of the idea relative to agriculture is to be found in the work of Hayami and Ruttan (Hayami and Ruttan, 11).

Hayami and Ruttan's model is designed to explain the processes whereby a country makes an efficient choice from amongst

alternative paths of technical development in agriculture. These paths are summarised as advance in either mechanical (labour-saving) or biological (land-saving) technology (1). The model hypothesises that the following mechanisms determine the choice between them:

(i) Induced innovation in the private sector.

Here it is argued that a firm conducting research will allocate its funds towards developing new techniques which economise on factors which are becoming relatively more expensive. Summed up to the macro-level, this will mean that, overall, a country's private research will be directed towards developing techniques which economise on the factor which is becoming relatively more expensive in that country.

(ii) Induced innovation in the public sector .

Since much of the research relevant to the agricultural sector is carried out by publicly-financed organizations, Hayami and Ruttan argue that it is necessary in this case to extend the induced innovation idea to show how public research institutions might be led to respond to changes in relative factor scarcities. They argue that interaction between researchers and farmers will lead scientists, in response to the farmers' demands, to develop techniques which economise on factors which are becoming relatively scarce and substitute for them inputs which are becoming relatively abundant. The necessary condition for this is that there must exist an incentive mechanism whereby researchers are rewarded to the extent that their work helps solve farmers' problems.

(iii) Institutional innovation.

Hayami and Ruttan further postulate that, where deamand conditions are favourable, individuals will be induced to change those institutional arrangements which stand in the way of achieving the full potential of new technology. "Changes in market prices and technological opportunities introduce disequilibrium in existing institutional arrangements by creating profitable new opportunities for the institutional innovations" (Hayami and Ruttan, 11, p.61). Nevertheless, they argue, there will be time lags in this process, arising from the economic and social conflict involved in institutional change. The greater these time lags the slower will be progress in

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(1) The following draws mainly on Hayami and Ruttan, 11, pp. 53-63.

selecting and achieving the efficient path of technical change.

(iv) Dynamic sequences.

Finally, they hypothesise that a major mechanism through which induced innovation works is the generation of disequilibrium or imbalance among the various parts of a technology. That is to say, the introduction of one innovation (presumably induced by changes in relative factor scarcities) creates bottlenecks within the technical system and through this leads to a cumulative sequence of technical changes as innovations to solve the bottleneck problems are introduced.

The Japanese case is one of the central examples cited by Hayami and Ruttan as evidence of the existence of the hypothesised mechanisms in the process of successful agricultural development. They suggest that the choice of a path of technical development in Japan was efficient in the sense that it represented a response to changes in the relative availabilities, hence prices, of factors of production. "Development of a continuous stream of new technology which altered the production surface to conform to long-term trends in factor prices was the key to success in agricultural growth in the United States and Japan" (Hayami and Ruttan, 11, p.135). This was achieved because the appropriate institutional mechanisms existed. "The success in agricultural growth in both the United States and Japan seems to lie in the capacity of their farmers, research institutions and farm supply industries to exploit new opportunities in response to the information transmitted through relative price changes" (Hayami and Ruttan, 11, p.135). For the case of Japan, their hypotheses could therefore be summarised as:

1. The choice of technique was successful because it resulted in the development of innovations which economised on the factor which was becoming relatively scarce (land) by substituting for it a factor which was becoming relatively abundant (fertiliser), ie. in production function terms, techniques with appropriate factor bias characteristics were developed and selected.

2. Since most research in the agricultural sector was carried out by public institutions, this must have been achieved by means of the existence of mechanisms whereby these institutions were able to develop new techniques with appropriate factor bias characteristics.

There are some theoretical problems associated with the induced innovation hypothesis (Salter, 27, pp.43-4), but our concern

is with its value in explaining evidence in a particular micro-economic case. Here there are broadly two sets of difficulties with the hypothesis, which arise in trying to transpose it from the macro to the micro level. Firstly, at the empirical level, it seems more realistic, in the light of, for instance, Rosenberg's survey of the development of a number of industrial innovations (Rosenberg,67), to regard firms as simply working to solve particular immediate problems, so that the issue comes down to asking what determines which amongst the various problems facing the firm it invests resources to try to solve. These problems include those arising from particular historical situations (such as wars, which lead to supplies of inputs' being cut off; accidents revealing problems with existing technology; government legislation; strikes) and those generated by the use of existing technology itself. "Complex technologies create internal compulsions and pressures which, in turn, initiate exploratory activity in particular directions" (Rosenberg,67,p.4).

Problem-solving of this last kind clearly resembles Hayami and Ruttan's dynamic sequences and it might be possible to trace the causes of a significant number of these cumulative processes, as of some of the other kinds of problems discussed by Rosenberg, back ultimately to changes in relative factor prices or supplies. The point that arises is simply that the step from relative factor prices to the firm's, or the research organisation's allocation of research funds is not a simple one. Making the step involves specifying how factor supply problems formulate themselves to the firm (and through the firm to the research organisations) in a particular technical and institutional environment. This involves relating the new technique to the existing economic and social conditions, as well as to the existing technology.

Secondly, it can be argued that there are other characteristics of new techniques, besides their factor bias, which are significant in determining their appropriateness to the environment into which they are introduced, and hence their diffusion and their effect on overall output. It would follow that the mechanisms whereby these characteristics are selected are also important. It is possible to list a number of such characteristics (Stewart,31,ch.4), but the following seem most relevant to new techniques in small-scale agriculture, especially where, as in the present case, they involve machinery:

1. Scale or divisibility, relative to the size structure of holdings and the institutional capacity to share the ownership or use of production inputs.

2. Mobility, relative to the existing investment in infrastructure (eg. field layout, irrigation facilities).

3. Complexity, relative to farmers' educational levels and their ability to use and maintain modern inputs and machinery.

The study therefore examines the development of a particular new technique, within the Japanese context, in the light of the induced innovation hypothesis and the problems with it. It considers which characteristics were important in the selection process, what determined the specific problems which the new technique was designed to solve, and how the institutional mechanisms linking farmers with research workers operated.

The development of theoretical approaches to the second, broader question of the relationship between technical, economic and social change is still in its early stages. There have, however, been studies of the determinants of the diffusion of new techniques amongst farms, which are relevant in that diffusion depends basically on the relationship between the characteristics of the new technology and the economic and social environment in which it becomes available. In the case of hybrid corn in the United States, as studied by Grilliches, the rate and pattern of diffusion could be explained quite simply in terms of the profitability of the new seeds to farmers in various regions, as measured by the size of the potential increase in yields and the average number of acres farmers planted to corn (Grilliches,54). In the case, again in the United States, of the diffusion of the reaping machine, a more complicated innovation in terms of its economic characteristics (involving scale economies and factor substitutions), David found that a more complex piece of reasoning was necessary to explain the time-profile of the diffusion, involving the interaction between scale economies, the demand for the product and relative factor prices (David,48). In the same way as was suggested earlier, the step from the changes in relative factor scarcities, which were acknowledged to be an important factor in inducing the adoption of the reaper (since it substituted capital for labour), to profitability at the farm level is not a straightforward one.

Furthermore, while it may be permissable in the case of

the United States to ignore differences between farm units in available factors and access to inputs, this is not the case in economies where markets are less highly developed. In less-developed countries, land, in particular, is valued as a source of power and influence as well as an input into agricultural production, and land markets, as markets for a production factor, are likely to be underdeveloped and imperfect. The distribution of access to supplies of irrigation water, a major factor conditioning the profitability of the adoption of many new techniques, is often institutionally rather than market determined and so also may be access to supplies of modern inputs like chemical fertilizer and technical advice. A technique which is profitable for one farmer, who has access to a particular set of factors or inputs, may not be profitable to another with access to a different set. In such a case, where markets for important production inputs either do not exist or function imperfectly, the diffusion of new techniques amongst different kinds of farmers will be influenced by the institutionally-determined distribution of productive assets (1).

If the diffusion of a new technique depends on the initial economic and institutional structure, then it is also likely that the reverse relationship will exist, so that the economic and institutional structure will be changed by the diffusion of the new technique. Hayami and Ruttan, with their institutional innovation mechanism, recognize that the availability of new technology affects the forces and incentives for institutional change. Gotsch (Gotsch, 53) has developed a framework of feedback mechanisms which specifies more explicitly the dynamic interactions involved. The characteristics of the technology, which are exogenously determined - the model is not designed to deal with the endogenous determinants of technical change- interact with the distribution of productive assets to determine the distribution of income and power. This in turn influences access to, and the characteristics of, organizations and institutions which serve agriculture, for instance, commodity markets, input markets, credit institutions, extension services. This feeds back to influence the distribution of productive assets as it interacts with the characteristics of (possibly newly-available) technology. For example, if technology which becomes newly available is labour-saving and has

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(1) For examples of the influence of this factor on the diffusion of Green Revolution technology, see Griffin,7.

scale economies (eg. agricultural machinery), and if the distribution of land, and therefore of income and power, is relatively unequal, then larger farmers are likely to have best access to the organisations serving agriculture, and therefore are likely to be best able to utilise the new technology. So their relative economic positions will be further improved and they will have profitable opportunities open to them for improving still further their position in the distribution of assets and income, eg. by evicting tenants, dismissing workers, etc..

Professor Ishikawa has also worked on the problem of developing a framework for analysing the dynamic economic and institutional effects of technical change in agriculture (1). In his framework, technical change, again with exogenously determined technical characteristics, interacts with an initial agrarian structure defined in terms of (i) the land tenure system; (ii) the size distribution of cultivated holdings; (iii) the decision-making processes of the various constituent types of farm household (eg. profit maximisation, the maintenance of a minimum subsistence level, etc.). This interaction sets in motion the following series of stages of response:

1. Primary response: the interaction generates a group of innovators who are the first to be willing and able to adopt the new technique. The major factors determining the size and character of this group are, on the one hand, the characteristics of the technology, especially the size of the increase in profitability (shift in the production function), factor bias and scale economies, and, on the other hand, the ways in which the initial structure determines access to and price of production inputs and risk-bearing ability amongst classes of farmers.

2. Secondary response: at this stage the effects of the initial introduction of the new technique spread through to alter the structure of the agricultural economy. This happens in two ways: (i) the innovation spreads at a different rate amongst different groups in the agricultural society; (ii) changes in the demand for

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(1) Ishikawa, 57. See also Ishikawa and Ohkawa, 59, in which the framework is used to analyse overall agricultural development in Japan, and in which also the possibilities of making technical change endogenous to the model are examined.

factor inputs resulting from changes in factor productivities affect groups within the society in different ways, so that the distribution of income from the ownership of production factors (factor shares) changes.

3. Tertiary response: this involves farmers in modifying the initially exogenously-given new technology as a response to the changes generated by the primary and secondary responses.

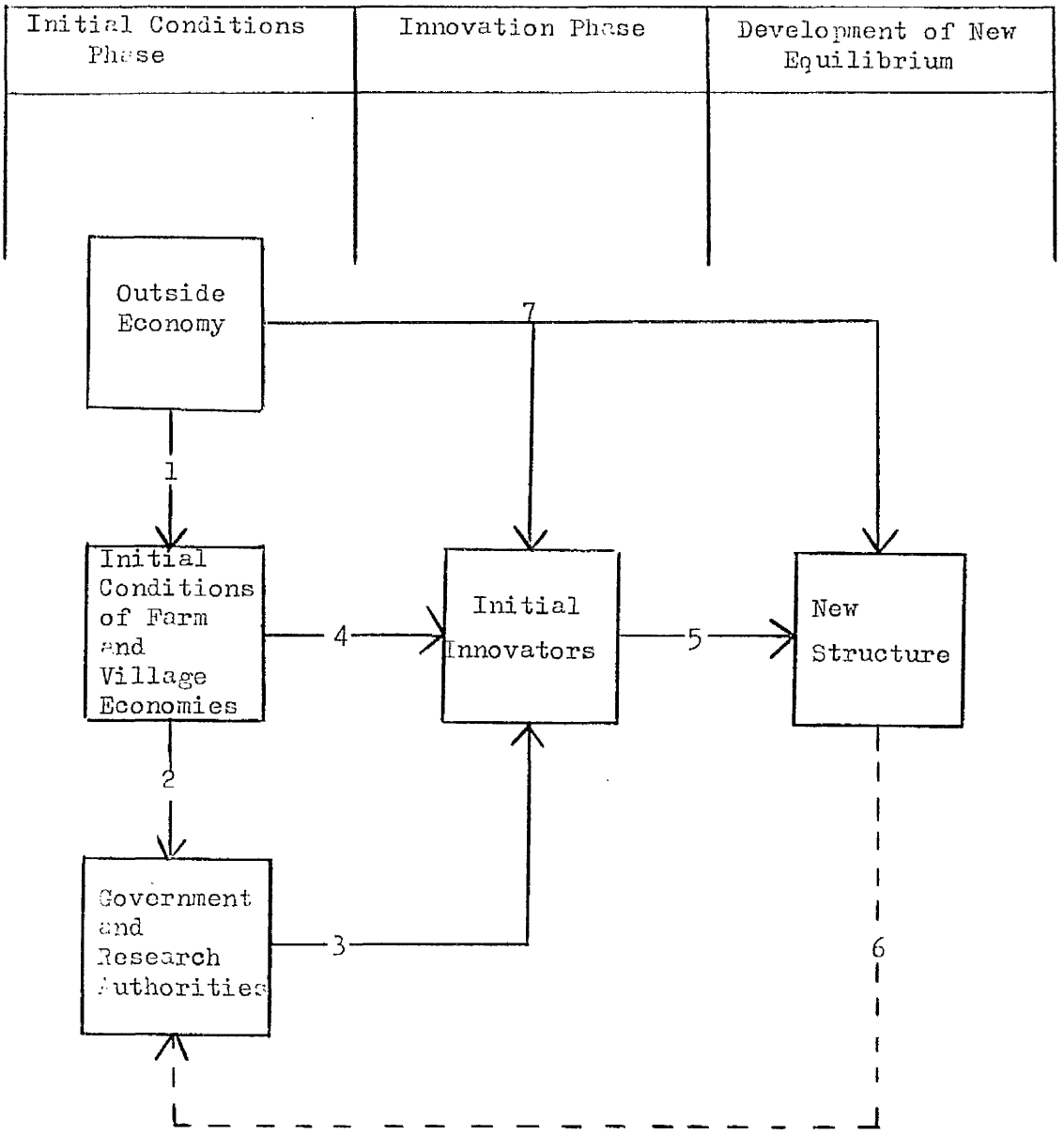
The ideas embodied in these models have been adapted to form the framework subsequently used to analyse the particular case and to help explain the relationship between technical, economic and social change which it reveals.

The answers to the two sets of questions set out above are clearly inter-related. The forces which determine the nature of new technology, even where they can ultimately be traced back to exogenous changes in factor supplies, work through the initial institutional and economic structure of the agricultural economy, which is itself linked to the existing technology. The characteristics of the new technology so determined influence the speed and nature of its diffusion. This diffusion in turn alters the economic and institutional structure through which subsequent endogenous technical change is induced.

The diagram (Fig. 1) is an attempt to put these inter-relationships into an analytical framework. It is not meant to be in any sense a working model, but is simply a device for relating the subsequent empirical case study to the theoretical questions and approaches suggested above. It is an attempt to show where the theories outlined above fit in, as explanatory hypotheses, in a particular story of technical change. It clearly draws heavily on the frameworks developed by Gotsch and Ishikawa and differs from them only in as far as it tries to make the determination of the characteristics of technical change from the start more explicitly endogenous to the system. This is more convenient, since the technical change under consideration was not an exogenous import to the particular area concerned but developed in response to the specific problems occurring there. Building this into the framework thus enables us to use the data to throw light on Question 1 as well as on Question 2.

I will begin by defining the items in the diagram and then set out the major mechanisms of inter-action between them.

Fig. 1.1: Diagram of the Framework



1. Initial conditions of farm and village economies.

This term stands for the initial internal economic and technical structure of agricultural production in the area or society under consideration. The basic micro unit of analysis is taken to be "the agricultural community", composed of farm households. In the present case, this is quite easy to distinguish as the village, which is the basic social and economic unit above the household in rural Japan. But a more general definition might involve specifying a group of farm households whose economic and social relationships with each other are of considerably greater significance to them than their relationships with households outside the group. The initial conditions in the community are defined principally in terms of:

(i) the characteristics of the technology in use, based on the available resource endowments.

(ii) the distribution of productive resources, especially land, amongst households, resulting from the historical development of the community as it inter-acted with environmental and economic conditions.

(iii) the internal economies of farm households, i.e. the ways in which different types of household make use of the available resources and technology.

(iv) the structure of economic relationships within the agricultural community, i.e. non-market economic relationships between households which influence the utilisation of resources by individual production units. It is assumed that market relationships between the households of the community are not significant.

2. The outside economy.

This refers to those economic units outside the agricultural community with whom community households have economic relations. The category includes:

(i) purchasers of the marketed output of the community.

(ii) firms supplying inputs to the community.

(iii) employers whose demand for labour is felt by the community.

3. Government and research authorities.

This covers those public organizations which are concerned with the development of agriculture and the diffusion of new techniques in the area of the communities in question, for instance, experiment stations, extension organizations, local government agricultural

departments, etc.. These organizations may be connected with higher-level scientific and administrative organizations reaching up to the national (or even international) level.

4. Initial innovators.

This corresponds to Ishikawa's category of the same name and represents those production units (households) which are the first to adopt any given innovation. The box really represents the disequilibrium structure of the village economy resulting from the emergence of the initial innovators.

5. New structure.

This represents the situation, parallel to, and defined by the same characteristics as, the initial conditions, after the diffusion of the innovation beyond the initial innovating group, and the technical and institutional adaptation necessary to restore balance. Ishikawa's phases 2 and 3 have been compressed into one in this category. In a dynamic sense, the new structure becomes the initial conditions determining the next process of technical change.

Before examining the inter-actions between these five terms, a little more explanation of the reasoning behind the idea of the initial conditions of farm and village economies is needed. The characteristics listed (i)-(iv) in this category, taken together, largely determine the ways in which natural resources, technology and social and institutional arrangements inter-act in the process of production and economic survival of the agricultural community. A basic theme underlying this approach is the idea that it is useful to regard the technical system and the economic relationships within and between households as uniquely adapted to each other in such a way as to make production and survival possible in a given natural environment and historically-determined institutional conditions. The idea is quite common in analysis of purely technological systems. The technique for carrying out one process in the system of producing a final good must balance with the techniques for carrying out the other processes. Disturbance of this balance gives rise to the kinds of problems which generate Hayami and Ruttan's dynamic sequences of technical change, as attempts are made to restore balance among processes. On the other hand, instead of being a stimulus to technical change, existing balance within the technology may affect the profitability of adopting, and hence the rate of diffusion of, an innovation in one technical process. This was the case, for instance,

with the reaping machine which was widely adopted in the United States but diffused much more slowly in Britain. David shows that a major factor in this was the existence on British farms of prior investment in the land (ridges and furrows, hedged fields, narrow roads, etc.) embodying the previous technology and incompatible with the use of the reaper. The need to alter field layouts and so on substantially raised the investment cost of the reaper so that it was profitable, at prevailing wage and interest rates, for far fewer farmers (David,49).

Expanding this idea to cover institutional change involves making the assumption that, just as there is adaptation leading to balance within the technology, so there is adaptation leading to balance between the technology and the economic organization of production. A change in either will disrupt the balance and lead to pressure for further innovation on either the technical or the institutional side, dynamic sequences in technology or institutional innovation in Hayami and Ruttan's terms. Alternatively, the existence of balance may raise the cost of adopting a technical or institutional innovation and so slow up its diffusion.

Furthermore, when the balance is disrupted, the structure of the initial interlocking technical and economic system will condition the nature and direction of the innovations attempted in order to restore balance. This is analogous to the way in which an existing technical system will condition, via the problem points which become most pressing, the subsequent technical changes (Rosenberg,67, pp.3-5).

For all these reasons, the specification of the initial conditions in terms of the characteristics listed and the relationship between them is necessary for an understanding of the forces which generate and determine the nature of technical change and its effects.

The channels of interaction between the terms are represented by the numbered arrows in the diagram. They are:

1. The initial conditions and the outside economy interact via the medium of markets - factor markets, agricultural input and output markets. It is clearly along this route that changes in relative factor prices would come to be felt by the community. It continues to operate throughout the process (arrow 7).

2. This route represents the forms of contact between the agricultural community and the research authorities, whereby researchers find out about farmers' problems and are pressed by them to

find solutions. The way in which this route works (eg. the kinds of farmer with whom the research authorities have contacts) will condition the allocation of research funds and time towards the solution of particular problems. Its existence would be a condition for induced innovation in the public sector.

3. The link between the research authorities and the initial innovating group is made by the characteristics of the new technology, developed in response to the interaction between knowledge of farmers' problems and available scientific knowledge.

4. This represents the ways in which the initial structure conditions the nature and number of initial innovators in response to the characteristics of the new technology. It works through the distribution, within the initial structure, of access to the inputs necessary for the adoption of the new techniques, including credit, ability to bear risk, educational attainments etc.. It represents Ishikawa's "primary response".

5. This is the process of adapting to restore balance within and between the technology and the economic structure. On the institutional side it is likely to work through changes in the distribution of land, income and political and economic power. On the technical side it would involve alterations in the characteristics of the new technology, in which case dotted arrow 6 may come into play, if the research authorities are brought into the process. It represents the institutional reaction to Ishikawa's "secondary response". Arrow 6 represents his "tertiary response".

The phases across the top of the diagram represent the sequence of changes in the system through time. In the initial conditions phase, the components of the internal farm and village economies (technology, distribution of assets, farm household economies, relationships between households) are in equilibrium with each other and with the outside economy and the governmental and research authorities. There might be, for example, a traditional technology utilised within a more-or-less unchanging structure of land distribution and economic relationships between households; static relationships with outside markets, eg. large farmers and landlords sell agricultural output, everyone else produces for subsistence; and a relationship with outside authorities such that the government levies taxes on agriculture and maintains some of the infrastructure, but makes no attempt to introduce new techniques.

The innovation phase occurs when something disrupts the equilibrium of the initial conditions phase. This disruption could stem, as in the present case, from the outside economy, via, for example, changes in demand or prices, or from within the agricultural economy itself, eg. population growth, or from the authorities, eg. introduction of new techniques, land reform. The disruption leads to pressure on the authorities and/or outside markets for the supply of new techniques. The results of this pressure will depend on the nature and strength of the relationships between the farm sector and the authorities and outside world. For instance, the relationship between farmers and authorities may not be strong enough for researchers to learn about or respond to the change in the conditions of the agricultural economy, in which case arrows 2 and 3 would not operate. If an innovation emerges, it will act on the initial farm and village economy to produce the initial innovator group, thus disrupting the original structure.

During the final phase, this disequilibrium is removed through adaptation of either or both of the farm economy and the technology. In the latter case, the authorities might be involved again.

The following study will attempt to use this framework to examine how the routes worked in a particular successful case. But before doing that it is perhaps necessary to define that success by placing the particular case against the background of Japanese agricultural development in general, and this is the purpose of the next chapter.

CHAPTER 2

Technical Change and the Economic Organisation of Agriculture in Pre-war Japan

This chapter is designed to serve as introduction and background to the subsequent discussion of agricultural development in one area of Japan, the Saga Plain. It will give a general picture of the organisation of agriculture and of technical progress in Japan in the period between the Meiji Restoration in 1868 and the Second World War. The first part describes the progress of Japanese agriculture, and Saga's place within it, in macro-economic terms. The second part outlines the background of technical, economic and institutional change in Japanese agriculture as a whole. The rest of the study will be concerned in detail with the nature of this change in the one particular region.

I. The Macro-economic Outline of Agricultural Development in Japan and in Saga.

This section is concerned with overall changes in agricultural output and inputs, beginning with the national trends summarised in Table 2.1, and going on to contrast them with trends in Saga.

1. The Rate of Growth of Agricultural Output in Japan.

Studies of the growth of agricultural output in Japan have revealed that, in two ways, the process is a more complex one than a first glance at statistical data might suggest.

Firstly, the statistical basis for growth rate calculations has been the subject of a great deal of controversy. Official government figures would give a growth rate of agricultural output of about 2.4% per annum for the period 1878 - 1922, slowing down to about 1% per annum in the subsequent inter-war period (Ohkawa et al., 23). These figures were strongly challenged by James Nakamura (Nakamura,18), who argued that they underestimated the level of output in the earlier part of the Meiji period because land areas and yields were concealed or misreported as a means of evading the

Table 2.1

SUMMARY TABLE OF TRENDS IN AGRICULTURAL OUTPUT AND INPUTS IN PRE-WAR JAPAN.

(5-yearly averages centring on years shown)

	Total Output* (Million ¥)	Rice Output* (Million ¥)	No. of Agricultural Workers (1,000)	Cultivated Land Area (1,000 ha)	Commercial Fertiliser Input* (Million ¥)
1880	1,332	970	15,588	4,735	29
1885	1,471	1,025	15,603	4,821	28
1890	1,594	1,075	15,629	4,924	28
1895	1,631	1,035	15,685	5,033	32
1900	1,845	1,167	15,830	5,193	40
1905	2,025	1,266	15,929	5,307	57
1910	2,269	1,390	15,875	5,574	101
1915	2,572	1,518	15,312	5,784	131
1920	2,735	1,619	14,001	5,983	177
1925	2,771	1,594	13,536	5,927	217
1930	2,975	1,662	13,971	5,975	266
1935	3,146	1,725	13,776	6,108	293

*1934-6 constant prices.

Source: Hayami, 10, Tables A1, A3, A4, and A6, from original data in LTES, 84.

land tax. However, this underestimation declined over time so that its effect was to make the growth rate in the early stages appear faster than it really was. Nakamura attempted to estimate a correct output series, and this yields a growth rate for 1878 - 1922 of only 1% per annum.

Nakamura's estimates were not generally accepted, but it was agreed that the growth rate had to be scaled down somewhat. This implied, firstly, that the levels of agricultural output and yields achieved before Japan began to industrialise were higher than previously thought, and, secondly, that the rate of growth of output, which had been thought to have resulted mainly from technical change, without any large-scale investment of resources in agriculture, was not as great as once thought. In addition, it is worth pointing out that Professor Ishikawa's work on the vital role played by irrigation facilities in bringing about yield increase through fertiliser-responsive seed varieties suggests that, whether or not high yields were already being achieved in Japan by the time of the Meiji Restoration, the potential for them had been created by the prior investment in the irrigation system (Ishikawa,12,ch.2,section 2). This meant that the simple picture of satisfactory output growth, concurrent with industrialisation, through technical change without the need for investment of development resources in agriculture, which had been held up as an example to developing countries, needed to be modified. It suggested that, whatever the actual growth rate was, output increase was linked in a more complex way to the particular conditions of Japanese agriculture.

The latest estimates of agricultural output and inputs have appeared as Volume 9 of the series Chooki Keizai Tookei (Long-term Economic Statistics of Japan since 1868, LTES, 84). They have not completely settled the argument, but in what follows LTES figures will generally be used when all-Japan totals are required. They yield an agricultural growth rate of about 2% per annum for 1878 - 1922, declining to 1% per annum after that. The slowing up of the growth rate in the period after the First World War is thus still apparent and the same kind of phasing can be observed in the LTES data for the output of rice, the most important crop and the one with which we shall be most concerned. The growth rate between 1880 and 1900 was 0.9% per annum, rising to 1.7% in 1900 - 1920, and declining to

0.4% in 1920 - 1935 (1).

Data for rice yields, another frequently-used measure of progress in Asian agriculture, present the same problems as the output data. Official figures for national average yields and for yields in the Saga area (Saga Prefecture or ken and Saga County or gun) are plotted in Chart 2.1. The original data for Saga are shown in Appendix Table 1. (For further discussion of the data used for Saga, see the note at the end of this chapter.) These may underestimate yields in the earlier years. According to Nakamura, whose estimates probably represent the maximum possible levels, national average yields in the 1870s ranged from 225 - 250 kg./10ares (Nakamura,18,p.104). At any rate, the same phasing is observable in the growth of yields as in that of output as a whole, with steady increase up to about 1918 and stagnation thereafter. Inter-country comparisons of crop yields are always dubious, but it is clear that the yields achieved in Japan were, by international standards, high, even in the early years and even using the minimum, official figures. The chart shows national average yields rising from about 200 kg./10ares in the 1890s to about 300 kg./10ares by the mid-1930s. Hayami and Ruttan calculate that the average paddy rice yield in 1963-5 in India was 150 kg./10ares, in Pakistan 170, in Thailand 160 (2). Ishikawa gives a figure for Mainland China in 1952-7 of 254 (Ishikawa,12,p.70). Yields in Saga, as the chart shows, were always well above the national average.

The second complication to the picture of output growth in Japanese agriculture results from the fact that the apparently more-or-less steady process covers a number of distinct regional patterns of growth, whereby new methods, developed in particular areas, spread gradually throughout the country. It is often pointed out that Meiji Period growth was a process whereby the opening up of the country after 1868 led to the spread of the best locally-developed techniques. But Professor Sawada has shown that this process continued in cycles throughout the pre-war period, with

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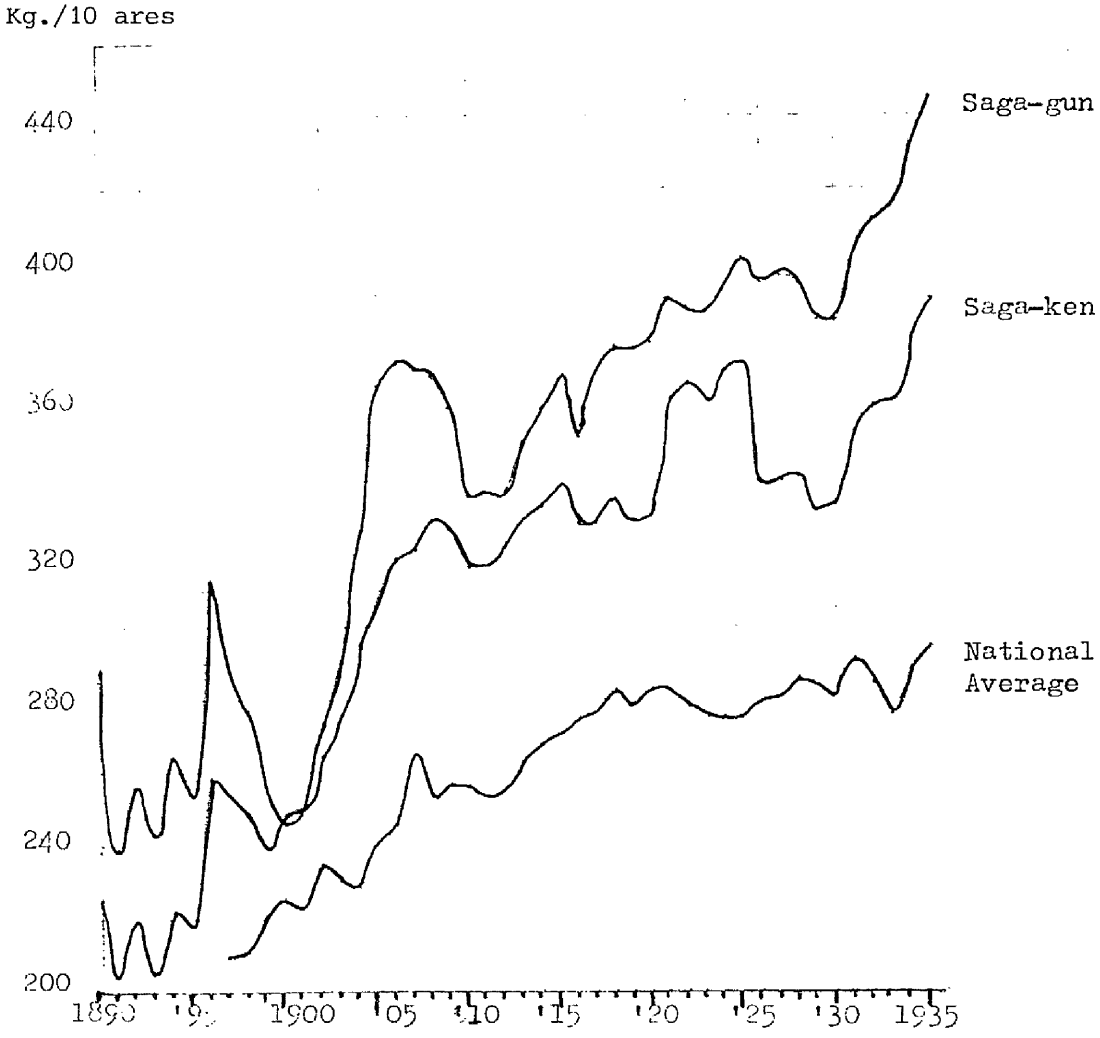
(1) Calculated by Hayami from 5-yearly averages of slightly adjusted LTES data. See Hayami, 10, p.20.

(2) Hayami and Ruttan, 11, p.195, using data from the F.A.O. production yearbook.

Chart 2.1: Rice Yields, 1890-1935, 5-yearly averages.



Sources: SKTS, 86, Nooshoomu Tookeihyoo, 85.

certain areas featuring as pioneers at every stage (Sawada,69). The simple overall growth rate thus hides this process of innovation and geographical diffusion.

In conclusion, then, we can probably say that agricultural output growth in pre-war Japan was steady, unspectacular by present-day standards, but adequate for the overall development of the economy. It would seem, though, that we need to disaggregate and look in greater detail if we are to further our understanding of the ways in which output growth occurred, how it related to changes in inputs, how agriculture was linked to the rest of the economy in the process, and, in general, what other countries can learn from the Japanese experience.

2. Changes in Inputs.

What were the sources of the output growth described above? In part they were the result of changes in the quantities of inputs used and in part the result of changes in technique. Changes in technique will be described in a later section. Here we are simply concerned with the changes in input quantities which occurred in generating the growth described in the last section. (For basic data, see Table 2.1.)

The cultivated land area increased at an annual average rate of about 0.5% until about 1920 (Hayami,10, p.26, based on LTES, 84). However, some of the new land consisted of non-paddy fields brought into cultivation in the northern areas of Japan. The area of paddy fields increased more slowly, at about 0.3% per annum. In the inter-war period this expansion came to an end. Thus increase in the cultivated area contributed something but not very much to the increase in output. Hayami estimates that at least 70% of the growth in output per worker is accounted for by increase in output per hectare, and therefore less than 30% by increases in land area per worker, in the period 1880 - 1935 (Hayami,10,p.30). The area actually planted to crops (i.e. allowing for double-cropping) grew at about the same rate as the cultivated area on average over the whole period 1880 - 1935. However, this conceals quite rapid growth in the rate of land utilisation in the period before the turn of the century, offset by some decline later on, in part caused by the fact that much of the expansion of the cultivated area was in northern parts of the country where double-cropping was impossible.

The agricultural labour force changed very little before 1900. It dropped quite sharply during the World War I boom and thereafter declined slowly. Over the period 1880 - 1935 it declined at the rate of 0.2% per annum. The estimation of actual labour input is a much more difficult matter. There are, as yet, no continuous estimates of labour input per hectare or labour days per worker. But there are suggestions that, during the Meiji period, these may have been increasing. Tussing, in his study of data from Yamanashi Prefecture in the Meiji period, found that the categorisation of workers according to their primary occupation in the official statistics tended to overestimate agricultural labour input in the early years (when agriculture was primary and manufacturing secondary) and to underestimate it in later years (when manufacturing was primary and agriculture secondary). He calculated that labour input into agriculture actually increased until the closing years of the Meiji period (Tussing,74). Ishikawa and Ohkawa also suggest that, although labour hours per hectare in rice cultivation were declining, this may have been offset by increased labour input in other operations (Ishikawa and Ohkawa,59,pp.161-2 and their Appendix Chart 2). During the inter-war period, however, labour input probably declined in as far as the number of workers did.

LTES gives estimates of the fixed capital stock in agriculture in terms of machinery and tools, livestock and plants, and farm buildings. This stock changed little over the pre-war period growing at no more than 1% per annum. But throughout the period a continuous process of investment in land improvement must have been going on. The introduction of drainage systems, without which double-cropping and animal ploughing were difficult, was widespread. Such investment is difficult to measure and is not taken into account in most studies of agricultural production functions (1).

Current inputs, most notably commercial fertilisers, grew more rapidly, especially after the turn of the century. The

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(1) This is of some significance relative to the debate on the growth rate and agriculture's role in development, since investment in land improvement could help to explain a relatively rapid growth rate in the Meiji period, but would also mean that the inputs required for agricultural development in Japan were greater than otherwise thought.

average annual growth rate was a little over 3% in the whole pre-war period but faster in the inter-war period than earlier. As an illustration, Table 2.1 shows increases in fertiliser input.

In terms of input combinations, the capital/land ratio must have been rising, and probably also capital per worker. Land per worker must have been rising a little but labour input per unit of land could have been increasing at least in the earlier period.

3. The Saga Plain in Comparison.

Detailed discussion of changes in inputs, output and technology in Saga, as compared with the national average, must wait until the major features of agricultural production on the Plain have been described. However, at this stage, it is worth making three points about the relationship between the overall pattern of growth in Saga and that in the rest of the country. Table 2.2 is designed to illustrate these points in a broad way. The nature of the data used for Saga is discussed in the note at the end of the chapter.

The first point concerns the rate of output growth on the Saga Plain. As Part 2 of the Table shows, the decade of the 1890s was a particularly poor one for Saga, containing the disastrous year of 1893 (when rice output was less than a third of normal levels) and several bad years around 1900. During the pre-World War I period the rate of growth of rice output speeded up dramatically from these low levels and was substantially greater than the national average. But what is really noteworthy about Saga's performance is the sustaining of relatively high growth rates of both rice output and total production during the inter-war period, when growth elsewhere slowed up markedly. For the period 1920-35, Saga achieved a growth rate of rice output of 1.3% per annum, compared with the national average of 0.4%, and of total output of 1.2% per annum, as compared with the 0.8% national average. This suggests that Saga did not follow the typical growth phasing observed elsewhere and that the rate of adoption of technical progress was sustained during the inter-war period, in contrast to the rest of the country. This is reflected also in the data on yields shown in Part 5 of the Table and in Chart 2.1.

The data used here for Saga are, however, precisely the official figures against which Nakamura launched his criticism.

Table 2.2

MACRO-ECONOMIC TRENDS IN SAGA COMPARED WITH THE WHOLE OF JAPAN

Part 1: Growth rates (% per annum) of the total value of all agricultural output, valued at 1934-6 prices.
(Calculations based on 5-yearly averages for years shown)

	Japan	Saga Prefecture
1880-1900	1.6	
1900-1920	1.8	
1920-1935	0.8	1.2
Source:	LTES	LTES Workbook

Part 2: Growth in rice output.
(% per annum between 5-yearly averages for years shown)

	Japan	Saga County
1890-1900	0.8	-1.8
1900-1920	1.6	2.3
1920-1935	0.4	1.3
Source:	LTES	SKTS

Part 3: Cultivated area per worker.
(Ha./worker, male and female)

	Japan	Saga County
1890	0.34	0.22
1900	0.36	0.23
1920	0.42	0.43
1935	0.44	0.46
Source:	LTES	SKTS

/Continued

Table 2.2 (Continued)

Part 4: Rice output per worker.
(Kg., 5-yearly averages)

	Japan	Saga County
1890	409	583
1900	448	504
1920	638	1,405
1935	684	1,842
Source:	LTES	SKTS

Part 5: Rice yields.
(Kg./10 ares, 5-yearly averages)

	Japan*		Saga County
1890	215	211	294
1900	226	222	246
1920	286	282	378
1935	297	294	444
Source:	LTES	Official	SKTS

Part 6: Rice as a proportion of the total value of agricultural production. (%)

	Japan	Saga Prefecture
1880	62.8	
1900	55.9	
1920	56.7	70.81
1935	50.2	66.38
Source:	LTES	LTES Workbook

Sources: LTES, 84; LTES Workbook, 87; SKTS, 86; official = Noorinshoo Tookei Hyoo, 85.

* LTES does not give figures for areas planted to individual crops. The LTES yield figures have been calculated using LTES production figures and official crop areas. As described in the text, LTES figures are not strictly comparable with the unadjusted SKTS figures. In the crucial area of yields, therefore, the official national data have been included for comparison.

There is, therefore, a suspicion that output and yields in the earlier years shown may have been higher than the official estimates. Bearing this out, Yamada found average rice yields in the villages in two areas of the Plain to have been recorded as 339 and 327 kg./10 ares respectively in 1857 (Yamada,81). The agricultural survey (Nooji Choosa) carried out in 1888 gave 358.5 kg./ 10 ares as the average yield for Saga County (Isobe,76,p.8). This is considerably higher than the first official figures shown in Chart 2.1. However, in the Saga-ken Choobunsho (Saga Prefecture Government Report) of 1909, the yield for Saga County is given as 370.5 kg./10 ares, which is closer to the trend of the official figures (Isobe,76,p.8). This would all suggest that yields did not rise as fast in the period up to the mid-1900s as the official figures show, but short of much more detailed study it is not possible to be conclusive. From our point of view though, this simply increases the significance of the relatively rapid growth observed in Saga in the '20s and '30s.

This significance is confirmed by Professor Sawada's findings on regional variation in the pattern of output growth (Sawada,69). He discovered that there were three points during the pre-World War II period when variation in rice yields amongst prefectures was at a peak. He took these points to represent times when new techniques adopted in the most advanced areas had not yet been diffused throughout the country. During the intervening periods other areas caught up with the advanced areas, narrowing the variation in yield. The prefectures with the highest yields at the times of peak variation (1887-93, 1903-7, 1933) were labelled pioneering prefectures. A few prefectures were pioneers at all three peak variation times. Saga was not a pioneer at the first peak but became one for both peaks after the turn of the century. At the first peak (1887-93), she was one of a number of prefectures achieving above-average yields but was not one of the five pioneering prefectures achieving over 250kg./10 ares. By the time of the second peak (1903-7), she had moved into the top group, now achieving over 300 kg./10 ares, with only Osaka and Nara prefectures, containing areas which had long been the most advanced and commercialized in the country, achieving higher yields. By the time of the third peak (1933), Saga had the highest yields in the country. This confirms Saga's significance in generating a relatively rapid rate of technical advance, especially in the inter-war period, and we can conclude that

Saga was unusual, in the context of the overall progress of Japanese agriculture, for both the speed and the phasing of its technical development.

The second point concerns the nature of this technical development. Japanese writers have named the mid-1930s the "Saga stage" (Saga Dankai) of Japanese agricultural development. This is not only because of Saga's rapid rate of output growth, which resulted in its having the highest rice yields in the country in the 1930s, but also because of the distinctive nature of its technical change. This resulted in the development of a specialised rice-producing technology, which generated both high yields and high labour productivity within a structure of small- or medium-scale family farms. This is the main subject of the subsequent chapters, but the impact can be seen in Parts 4 and 5 of the table. Rice yields on the Saga Plain were always above the national average for climatic and environmental reasons. But the difference rapidly increased after the turn of the century and continued to do so during the inter-war period when growth in national average yields was slowing down markedly. (See Chart 2.1) Rice output per worker shows the same comparative trends. Trends in total output and income per worker would not show quite such a marked divergence, however, because other areas were diversifying into other crops and activities to a greater extent than Saga. Nevertheless, the distinctive trends in the technology of rice production on the Saga Plain can clearly be seen.

The third contrast at the macro-level between Saga and the national average lies in the differences in the resource structure on which changes in technology were based. Part 3 of the table shows the rapid rise in cultivated area per man in Saga, as opposed to the whole country. This is partly the result of the low initial level in Saga, arising from the initial resource endowment and cultivation methods, and partly the result of the very rapid decline in the labour force. The number of agricultural workers in Saga was declining at 1.4% per annum in the period 1888 - 1935, as compared with the 0.2% national average, while the cultivated area increased rather more slowly than average. The peculiarities of Saga's natural environment, in particular the very high proportion of the cultivated area which could be irrigated, affected the output structure, relative to the national average, as well. They resulted in the specialisation

in rice cultivation which is revealed, in Part 6 of the table, in the much higher proportion contributed by rice to the total value of agricultural production.

Thus we can conclude that, as compared with the national average, output growth in Saga was rapid, especially in the inter-war period, techncial change took a distinctive form, and peculiarities in the nature and relative availability of resources underlay the differing trends.

II. Technical, Economic and Institutional Change in Pre-war Japanese Agriculture.

This section examines the economic and organizational changes which accompanied the pattern of growth described above, and the technical changes which generated it.

1. The Socio-economic Organization of Agricultural Production.

(i) the household.

The basic unit of production in Japanese agriculture has always been the household (ie), that is to say, the members of a family living together under one roof. At times it is necessary to interpret "family" quite widely in order to include unrelated people adopted into the household, but even in such cases the fiction of a family relationship was more-or-less closely maintained and the adopted person lived as a member of the household. Families with larger holdings would also take into their households members of other poorer families. They were employed as household servants and agricultural labourers and lived within the employer's household. There may have been as many as a million of these workers (out of an agricultural labour force of 14 or 15 million) in the middle of the Meiji period, but, as we shall see later, this form of farm management became less common over the course of the pre-war period, and the number of agricultural labourers had declined to 384,000 by 1920 (Ishikawa and Ohkawa,59,pp.168-9). Increasingly larger landowners came to rent out land which they did not cultivate themselves to tenant households, rather than incorporate additional members into the household.

Thus the typical farm unit in pre-war Japan was based on the household, which both managed the cultivation of the land (whether owned or rented) and supplied the labour to work it. At the centre of the household was the nuclear family of the household head, the headship passing to his eldest son when he became too old to manage the farm. If the family had enough land, younger sons and their families would be given a portion of the main family's land and set up as more-or-less independent branch households. If they could not be supported in this way, they would either have to become adopted sons, tenants or household servants of other families, or remain unmarried and supported as far as possible by their original families. With the progress of industrialisation, non-agricultural employment opened up other opportunities for the younger children of rural households.

The basic household unit, whatever its size, did not farm a compact holding centring on the house in which the family lived. It usually farmed a number of separate plots scattered about within the land area controlled by the village in which it was located or, occasionally, by other nearby villages. In almost all areas some of the plots would consist of paddy land, fitted into the village's irrigation system, on which paddy rice could be grown. Other plots consisted of so-called upland fields, i.e. fields which were not included in the irrigation network and were not therefore suitable for rice cultivation.

The household was regarded as a body with a continuous life of its own, independent of, though not unaffected by, the lives and deaths of its individual members. It was the household, not its members or even its head, which was socially, administratively and legally regarded as the basic unit of the village community. The household might expand the holding it cultivated here or decrease it there, its fortunes might rise or fall, but it would remain in existence as an agricultural production unit. The number of agricultural households in Japan remained almost constant at about 5½ million over the entire pre-war period.

(ii) the village.

The village was the basic social and administrative unit in Japanese rural areas throughout the Tokugawa period and, despite subsequent changes in the structure

of local government, has remained so ever since (1). Typically it consisted of a group of households, not usually exceeding 200, with their house sites collected together and surrounded by the fields cultivated by the village members. The number of villages in Japan has changed very little since 1868.

The most important basis of village cohesion was the irrigation system. Irrigation facilities were normally constructed in such a way that each plot formed part of an interlocking system around which water flowed from one plot to the next. The irrigation system therefore had to be maintained and managed by the village members as a group to ensure that, barring cheating and stealing, the available water supply would be equitably distributed to every paddy field, hence to everyone's scattered holdings. The village often also owned and managed land from which fertiliser could be collected and this provided another material basis for cohesion and collective security. Membership of the village brought with it, along with rights to village-owned facilities, duties which were communally shared. These included the repair of village roads and the organisation of festivals. A household's membership of a village community was thus a kind of citizenship, giving it rights and duties which were essential to the security of the whole group.

This overall village community was broken down into a number of constituent groups. Chief among these were those based on family relationships between households (doozoku). The practice of giving younger sons, and sometimes even long-serving household servants, parcels of the family's land on which to set up their own farms created ties between households. The branch household (bunke) and the main household (honke) continued to help each other economically, supplying labour, tools, financial assistance and so on. More complex structures developed as branch households themselves formed branches. Similar kinds of relationship between households could be found (e.g. between landlord and tenant households) even where they were not based on family ties. Neighbourhood groupings also existed, within which households

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(1) The term village is used to refer to the basic village unit called mura in Tokugawa times. The word mura now applies administratively to a larger area often containing several former mura, which are now called buraku, ooaza or ku.

supplied each other with all kinds of assistance. Altogether, the village community was interwoven with mutual relationships, of a more-or-less hierarchical kind, between independent households.

These relationships cemented the various layers of village society because they were mutually beneficial to both superior and inferior constituents of the hierarchy. The branch household/tenant/small farmer was obliged by the relationship to provide workers when the larger-scale main household needed them, thus assuring it of its labour supply. In return, the richer household had a duty to give assistance when it was required, in the form of meals, gifts, loans, rent reductions in bad years, and so on, thus assuring the survival of the poorer household (Nakane,19, pp.112-3). These relationships formed the basis of the kind of insurance of subsistence that the village community provided for its members.

(iii) Landownership and tenure.

Before the Meiji Restoration in 1868, private ownership of land did not technically exist. Each cultivating household farmed by custom an area determined by the history of the family. It owed allegiance to a feudal lord and his retainers (samurai), who did not cultivate land but lived, in castles and their surrounding towns, on the taxes and dues paid by the cultivators. Land could not be sold, and cultivators were forbidden to leave their villages and their traditional plots, or to take up other occupations. Tenancy was also forbidden, but in practice it arose in a number of ways, especially as the economy became more commercialised towards the end of the Tokugawa period. Cultivators who got into debt to moneylenders or traders ended up losing ownership of their land and came to pay what was, in effect, rent to their creditors. Labourers who were originally household servants of larger landowners came to be given land to cultivate themselves as tenants (1). It has been estimated that, through these and other means, about 20% of households might have been pure tenants after the Meiji Restoration, and perhaps 35% part-tenants (Dore,4,p.17).

After 1868, legal titles to land were distributed, and it

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(1) For a full description of this process, see Smith,29, especially chapters 8 and 9.

became possible for cultivators to sell their land or to change occupation. The feudal dues were abolished and, in their place, the government levied a land tax. The burden on the cultivator remained much the same but the new tax had to be paid in cash instead of kind and this drew farmers more and more into commercial markets, as they strove to raise the money to pay their taxes.

The land tenure structure which emerged from the changes of the Meiji Restoration was a mixture of pure owner, pure tenant, part-owner/part-tenant, and cultivator/landlord households. There were some completely absentee landlords, whose business, even where they did do some cultivation, essentially lay in the management of their property. But most landlords were not like this. They ranged from the relatively large-scale village landowner who cultivated some of his land and rented out the rest, and who was an influential person within village society, to the government official who had not enough time to cultivate all his land, or to the man who rented out a distant plot in order to rent in a more convenient one.

In terms of size, the distribution of land ownership was such that only a small proportion of landowners owned holdings which could be considered large. Table 2.3 shows that in 1908 less than 10% of households owned more than 3ha.. For cultivation purposes, the predominant farm unit was the household cultivating less than a hectare. As Table 2.4 shows, about 70% of farm households fell into this category throughout the pre-World War II period, and the effect of the renting out of land was to even out the distribution of cultivated holdings as opposed to owned ones (1).

However, it was the group of larger landowners who both cultivated and rented out land (known as tezukuri jinushi in Japanese) which provided the leadership of village society at this time. Village chiefs, heads of agricultural associations, co-operatives, and so on, tended to come from the one or two larger landowning families to be found in most villages. However, in spite of

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(1) By contrast, Professor K.N. Raj has pointed out (in his series of Radhakrishnan Memorial Lectures, delivered at the University of Oxford in April and May, 1977) that in India the leasing in and out of land does not have this effect. There, land is usually leased to medium- or larger-scale cultivators, so that the distribution of cultivated holdings is similar to that of owned holdings.

Table 2.3

THE DISTRIBUTION OF HOUSEHOLDS BY AREA OWNED

(Whole Country, %)

	Under ½ ha.	½-1 ha.	1-3 ha.	3-5 ha.	5-10 ha.	10-50 ha.	Over 50 ha.
1908	46.1	26.1	18.8	5.6	2.5	0.8	0.05
1910	47.4	25.7	17.9	5.5	2.6	0.8	0.06
1915	48.5	24.8	18.1	5.3	2.5	0.8	0.07
1920	49.3	24.3	18.1	4.7	2.5	1.0	0.09
1925	49.8	24.4	17.8	4.6	2.3	0.9	0.08
1930	49.8	24.8	17.7	4.4	2.2	0.9	0.07
1935	49.6	25.3	17.6	4.3	2.2	0.9	0.07
1940	47.6	26.3	18.6	4.4	2.1	0.9	0.10

Source: Kayoo, 83.

Table 2.4

THE DISTRIBUTION OF HOUSEHOLDS BY AREA CULTIVATED

(Whole Country, %)

	Under ½ ha.	½-1 ha.	1-2 ha.	2-3 ha.	3-5 ha.	Over 5 ha.
1908	37.3	32.6	19.5	6.4	3.0	1.2
1910	37.6	33.0	19.3	5.9	2.9	1.3
1915	36.6	33.4	20.0	6.1	2.7	1.2
1920	35.3	33.1	20.7	6.2	2.8	1.7
1925	34.8	33.9	21.5	5.9	2.5	1.4
1930	34.3	34.3	22.1	5.7	2.3	1.3
1935	33.7	34.3	22.5	5.8	2.3	1.4
1940	33.4	32.8	24.5	5.7	2.2	1.4

Source: Kayoo, 83.

their influential position within the village, most of these landowners were not highly privileged within Japanese society in general. In 1936, according to Dore, the rent from 6½ ha. would have been necessary to generate the income of an urban civil servant or teacher (Dore,4,p.29). Admittedly, by that time the position of agricultural income-earners may have declined relative to that of urban earners as compared with earlier periods, but nevertheless very few landowners owned as much as 6½ ha..

There was no marked or revolutionary change in the basic features of this structure in the pre-war period. The small-scale family farm remained the basic unit throughout. Nevertheless, gradual changes can be observed and are significant in terms of their relationships with technical change. These will be examined later. For the moment, the changes will simply be outlined. To do this, it is convenient to split the period into two, with the division falling roughly at the time of the First World War. This corresponds to the phases in output growth observed earlier. The pace of change varied considerably amongst regions, and the phasing is thus only approximate. In the less-developed parts of the country, particularly in the north-east, traditional patterns of landownership and economic organization, centring on the doozoku system, were still in existence at the time of the post-war land reform. In more developed areas, the distribution of land ownership and the nature of relationships between households had begun to change even before 1868. Nevertheless, Japanese writers have distinguished the following two general phases:

1. 1868 - World War I

This period saw what Japanese writers have called a bi-polarization of the agricultural structure. Tenancy continued to increase and there was probably some rise in the proportion of households in the lowest size scales. Reliable data for this period are hard to come by, but Oouchi estimates that the proportion of owner-farmer households fell from 37.3% to 33.3% between 1883/4 and 1908, while the proportion of pure tenant households rose from 20.9% to 27.6% (Oouchi,39,p.91). Ishikawa and Ohkawa estimate that the proportion of tenanted land rose from 29% in 1872 to 45% in 1908 (Ishikawa and Ohkawa,59,p.167).

The mechanisms behind this process were complex. Abstracting for the moment from the influence of technical progress,

the changing economy of Japan at this time generated a number of forces which tended to worsen the position of the small-scale farming household, driving it into tenancy, whilst at the same time improving the position of the larger landowner. The changes of the Meiji Restoration did nothing to alleviate the burden of taxes and rent on the small-scale owner or tenant farmer, and in some ways made it harder to bear. The new tax, unlike the old ones, did not vary with the state of the harvest and in order to raise the cash to pay it the small farmer often had to sell rice immediately after the harvest, when the price was at its lowest. On the whole, the price of rice was rising during this period, as the commercialization of the economy raised the demand for it. But this was not so during the deflation caused by the government in the 1880s, when many small farmers fell into difficulties. In general, the rising price of rice benefitted the small farmer only marginally, since there was little rice left for him to sell after payment of rent, taxes, interest, etc., and after meeting the family's food needs.

Increasing tenancy was the result of the impact of these economic forces on the smaller farmers. They would find themselves in difficulty as a result of a bad harvest, a poor price for rice, a wedding or a funeral that had to be paid for. They would borrow money, mortgage their land and gradually lose ownership of it. In this situation there was little to do but hope to continue farming as the tenant of the new landowner. Industrial employment was never able, in the pre-war period, to make any impression on the absolute numbers on the land. At this stage, it might have been possible to find employment for a farm daughter for a few years in one of the silk-reeling factories springing up in the countryside, but the demand for permanent male industrial labour was not great. Thus tenancy increased and the small-scale farmer struggled.

The larger landowner, on the other hand, faced no such problems. Having more rice to sell, both from his own produce and from what he received as rent, he was able to benefit from good prices, and he had no difficulty paying his taxes. As we shall see, the larger-scale cultivating landlords were the leaders in adopting improved techniques in this period, and, as output rose, the burden of the more-or-less fixed land tax payment declined. As landlords, the larger landowners also benefitted from increased yields obtained by tenants. Even if it was difficult to raise customary rent levels,

the need to reduce rents in bad years declined as tenants came to achieve higher and more stable yields, and, with the continued pressure of population on the land, rents did not decline as a proportion of rising total output in this period. Thus economic change benefitted the larger-scale cultivating landlords through higher yields on the land they farmed, a high price for the rice they had to sell, and high levels of rent on the land they leased out.

2. World War I - the late 1930s

This period saw something of a reversal of the trends of the previous one. The increase in the proportion of pure tenants was halted and the part-owner/part-tenant group became predominant. There was also a tendency for the proportion of households farming middle-sized holdings to increase at the expense of larger and smaller landowners and cultivators. The period has thus been characterized as that of the rise of the medium-scale, owner/tenant farmer. Table 2.5 shows the gradual increase in the proportion of owner/tenant households from about 39% of all households in 1908 to about 42½% by the time of the Second World War. Meanwhile, as Table 2.3 shows, the proportion of households farming 1-2 ha. rose from about 19½% in 1908 to 24½% in 1940, as the proportions in the largest and smallest size scales declined. Chart 2.2 is designed to illustrate the same tendency for the purposes of subsequent comparisons.

The causes of these trends must, in many respects, lie in the spread of new techniques amongst smaller-scale farmers towards the end of the previous period, and this will be examined in greater detail later, but other factors intensified the trend. Four years' school attendance became compulsory in 1886 and, by the turn of the century, at least 80% of school-age children were enrolled (Japan, Ministry of Education, 14). Thus by the inter-war period, a majority of farmers would have had some education and would probably be literate. This not only affected their ability to adopt new techniques but also lessened their political and social dependence on the leading village landowners. Their economic and social position was also strengthened, at least in some areas, by the increasing demand for permanent, full-time, male labour in the now expanding heavy industries. These factors made the period one of increasing conflict between landlords and tenants. Tenants' unions were formed throughout the country, countered by the formation

Table 2.5

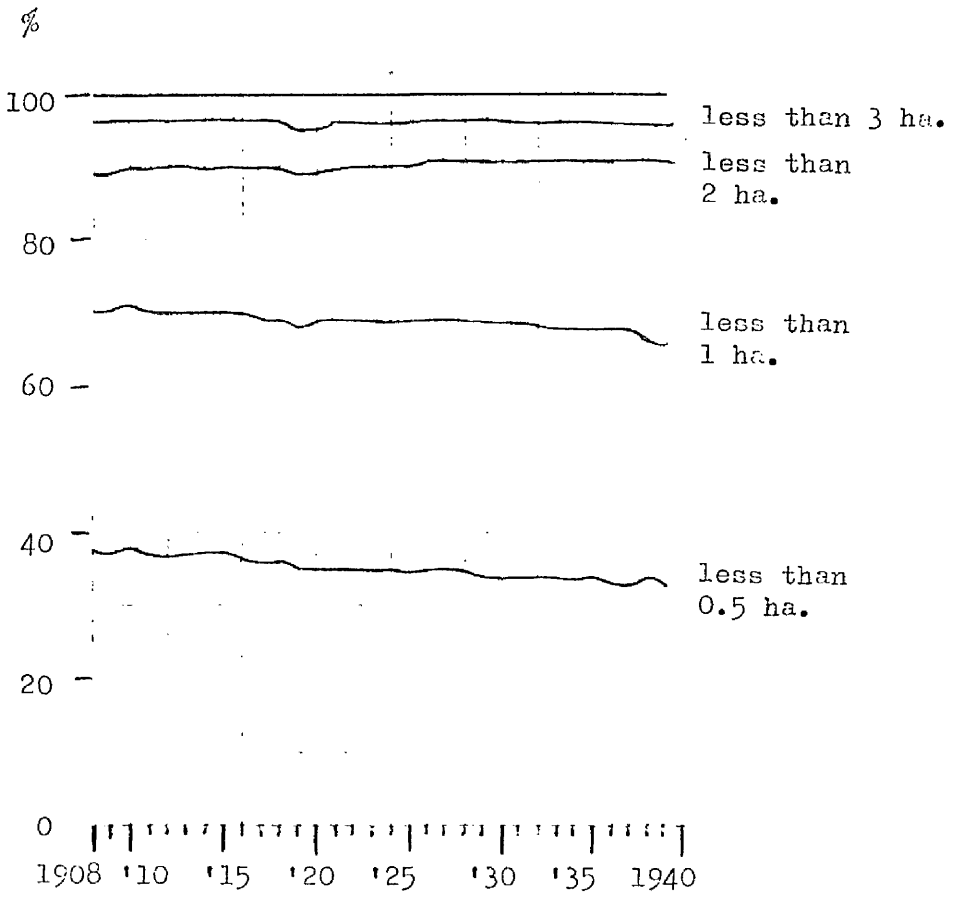
THE DISTRIBUTION OF AGRICULTURAL HOUSEHOLDS BY STATUS

(Whole Country, %)

	Owners	Owner/ Tenants	Tenants
1908	33.3	39.1	27.6
1912	32.5	40.0	27.5
1917	31.0	40.9	28.1
1922	30.6	41.1	28.3
1927	30.7	42.1	27.2
1932	30.5	42.7	26.8
1937	30.5	42.3	27.2
1940	30.5	42.4	27.1

Source: Kayoo, 83.

Chart 2.2: Cumulative Pecentage Size Distribution of Cultivated Holdings, National Average 1908-39.



Source: Calculated from data in Kayoo (83).

of landlords' federations, and there was an increasing number of disputes between landlords and tenants which had to be resolved by legal or police measures. Given the increased power of the tenant, higher yields, combined with customary rent levels which were hard to raise, meant that a decreasing proportion of the harvest was being paid as rent.

These factors tended to worsen the position of the larger landowner. Those who cultivated some of their land were finding it harder to obtain the necessary non-family labour and, with the spread techniques which made careful cultivation even more vital, farming of larger holdings became increasingly difficult. Non-cultivating and absentee landlords became much more common in this period. However, rents from leased-out land were not keeping up with increases in output. The price of rice was very high around the time of the First World War, but thereafter, with depressed conditions in the economy as a whole, demand was less buoyant and the price was also being held down by increased imports from Taiwan and Korea. These factors made land a much less attractive investment than it had been, especially given the alternative opportunities for investment in industry.

The rise of the middle-scale farmer can be seen as the result of the conjunction of these forces. As larger cultivator/ landlords reduced the area they farmed and larger landowners began to take their money out of land, small-scale farmers began to acquire the released land, either to rent or to buy, raising the scale of their cultivation and probably moving into the owner/tenant category. One of the principal arguments of this regional study is that this trend was related to, and re-inforced by, technical change.

After the war, the land reform, executed under the American Occupation, drastically re-inforced the pre-war trend by achieving the transfer of the ownership of almost all leased-out land to the former tenants, and setting a ceiling (on average 3 ha.) on the area a household could own. The small- to medium-scale family farm was thus firmly entrenched as the basis of the agricultural structure. It remains so to this day, although the picture is complicated by the fact that almost all Japanese farms are now cultivated on a part-time basis.

(iv) The village and the outside world.

So far we have considered only the internal structure of the village and the farm household. But the development of Japanese agriculture in the pre-war period is in part the history of the inter-relationships between agriculture and the developing industrial sector, between the village and the outside world. At the time of the Meiji Restoration, the commercial development of the economy was already exerting an influence on agriculture, and, indeed, agricultural productivity was high enough to support what was, by the standards of contemporary under-developed countries, a relatively large urban or non-cultivating population. In the areas supplying the larger urban centres, commercial farming was already developing and leading to the adoption of improved cultivation methods. Nevertheless, the production of most farms was still essentially for subsistence. This pattern was broken by the introduction of land tax payments in cash, as we have seen, and by the impact of industrialisation, which developed in earnest after the turn of the century.

The village economy was drawn into relationships with outside markets that fall broadly into two kinds. Firstly, it was drawn into commercial markets for goods, partly by the need to sell agricultural produce in order to be able to pay taxes, and partly by the wish to buy consumer goods and production inputs as they became available. The increased marketed output of Japanese agriculture was sufficient to meet the demands of the expanding urban and industrial population until about the time of the First World War, when boom conditions, fuelled by speculation, forced the price of rice up to unprecedented levels and the government launched its scheme to expand the production and import of Japanese-type rice from Taiwan and Korea. At their peak in the inter-war period, colonial imports supplied 20% of the Japanese demand for rice. Meanwhile, Japanese farm households were beginning to substitute industrially-manufactured consumer goods for those they had previously made themselves, and to expand their purchase of commercial fertiliser.

As farmers became more and more involved in commercial markets, they began to diversify and specialise their production. Before World War I this was chiefly to be observed in the expansion of sericulture. The depressing effect of imports on rice prices and the collapse of the market for silk in the inter-war period,

encouraged farmers to diversify a little further into fruit, vegetables, livestock and so on. Nevertheless, rice retained its dominant position.

The second way in which the industrial development of Japan affected the village economy was by way of the demand for labour. This was never sufficient to cause a large-scale reduction in the agricultural population, which remained roughly constant throughout the pre-war period. But it drew off the increase in that population and its regional impact was at times, as we shall see, sharp. In the early stages of industrialisation, factories succeeded in tapping resources of under-utilised labour time in agriculture. The early silk-weaving factories were located in the country and employed the unmarried daughters of farm families. But as urbanisation increased younger sons and daughters left the farms altogether and went to live in the cities.

Such market relationships were not, however, the only form of contact between the village and the outside world. From earliest times government authorities had taken an interest in agriculture, it being the most important source of revenue, and had encouraged irrigation and land-improvement projects. On the other side, there were, throughout the country, farmers who were interested in working to develop new techniques and improve agriculture. After the Meiji Restoration these farmers began to form "agricultural discussion groups" and "seed exchange societies" in order to spread their knowledge and interest. The Meiji government developed institutions which harnessed and built on this experience and enthusiasm, as a means of spreading new techniques down to the village level.

To begin with, the local agricultural organisations were encouraged and developed and eventually made official under the pyramidal structure of the National Agricultural Association (1894), which later became the Imperial Agricultural Association. Skilled farmers were encouraged to travel around the country, lecturing to local groups on improved techniques. After the turn of the century the establishment of co-operatives also began to be encouraged by means of subsidies and other kinds of assistance, and these provided farmers with credit, marketing and purchasing facilities.

Having thus organised and, at times, forced the

enthusiasm of the farmers for agricultural improvement, the government began to put something into the system from its side by means of expenditure on the research and development of new techniques. The National Agricultural Experiment Station was set up in 1893. In 1899 a law was passed to permit subsidies for the setting up of prefectural experiment stations. By the inter-war period this network of research facilities had developed sufficient expertise to be able to produce significant results (e.g. cross-bred seed varieties) which it was able to diffuse to farmers through the agricultural societies (1).

2. Technology.

(i) resources and production techniques.

Japan is a small and crowded set of islands of which only 14% of the land area is at present cultivated. Its man/land ratio has been unfavourable throughout its development process, even when compared with some of today's developing Asian countries (2). Paddy rice has always been by far the most important crop grown by Japanese farmers. Before 1900 it was generating between 50 and 60% of the value of agricultural output and continued to produce 40 to 50% up until World War II (Calculated from LTES, 84). So we can begin to view Japanese agricultural technology as a response to the requirements of paddy rice cultivation in Japanese conditions.

In order to grow paddy rice it is necessary to be able to provide standing water in the fields during the growing period of the plant. There are few places in Japan where this can be achieved naturally, as it can in monsoon climates and on the flood plains of rivers elsewhere in Asia. From earliest times, therefore, the construction of irrigation systems has been a precondition for successful agriculture in Japan. Professor Sawada has calculated

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(1) For more detailed accounts of the research and extension system in Japan, see Ogura, 21, pp. 299-330, or Hayami and Ruttan, 11, pp. 153-162.

(2) Agricultural land area per male worker was around one hectare at the end of the nineteenth century, rising to 1.3 ha. by the thirties in Japan. In 1957-62, it averaged 1.9 ha. in India, 1.3 in Sri Lanka, 2.0 in the Philippines. See Hayami, 10, p.8.

that 70.9% of the ponds and 73.7% of the river irrigation facilities in existence in the 1960s were first constructed before 1868 (Sawada,69,pp.124-5).

This huge investment in land improvement created the ability to provide a controlled and regulated supply of water to the paddy fields and reduced somewhat the influence of the weather on the harvest. Within the framework of this irrigation system rice cultivation techniques developed and changed in ways which will be described in the next section, but their central features remained much the same throughout the pre-war period. Rice seedlings were first grown from seed in seed beds and then transplanted into the ploughed, irrigated and fertilised paddy field. Hoeing and weeding were meticulously carried out, using at first simple and later more sophisticated hand-powered tools. Planting and harvesting were carried out by hand throughout the period, although some other operations, notably threshing, were becoming mechanised during the 1930s. Ploughing using human power was replaced by the use of draught animals during this period, but the technology remained characterised throughout by the intensive use of labour to produce high rice yields on limited land areas.

Where drainage facilities were adequate and climate suitable, winter crops could be grown on the paddy fields, and, with improvements in irrigation facilities, there spread rotations in which other grain crops (wheat, barley or naked barley) were grown on the paddy fields after the rice crop. Elsewhere the water remained in the fields, which were fallow throughout the winter. On the 40-50% of the cultivated area which is not suitable for rice cultivation a large variety of other crops could be grown. These included subsistence crops such as vegetables and beans, commercial crops such as tea and industrial crops such as mulberry. Except in Hokkaidoo, domestic animals were almost always stall-fed, and although the production of livestock products increased rapidly over the pre-war period it never generated a very significant proportion of the value of agricultural output.

The inputs which these techniques required were, at the beginning of the Meiji period, largely self-supplied within the farm or the village. The household had available to it its land holding, embodying the investments of generations, and the household labour force, sometimes supplemented, in the case of larger-scale

farmers, by hired labour. Irrigation water was supplied to all by the communal village system. Fertiliser was of great importance, especially as double-cropping of paddy land increased. Throughout the period much fertiliser was self-supplied, mainly in the form of grass and leaves collected from communal village land. However, the use of commercial fertilisers, at first organic and later chemical, became more and more important. The household's capital stock consisted mainly of buildings and tools, along with fruit trees, tea bushes and so on. Larger farmers owned draught animals, smaller ones hired or borrowed them.

The various changes in inputs and techniques which produced the rise in output of the pre-war period will be outlined next. But it must be remembered that alongside them there remained the basic facts of Japanese agriculture: small fields making up small holdings; intensive cultivation by the labour of the household; the predominance of paddy cultivation of rice with hand techniques; and the framework of the village irrigation system and co-operative functions.

(ii) technical change in the pre-war period.

The set of improved agricultural techniques which was spreading throughout Japan during the period after 1868 and was widely in use by the 1910s is known, by Japanese scholars, as the Meiji Noohoo (Meiji agricultural methods). It can be characterised as the development and diffusion of the best techniques available within the traditional system. The opening up of communications throughout the country after 1868 facilitated the spread of ideas, and we have seen how the government encouraged skilled farmers to develop and teach the best techniques then known. The inputs required for this process were largely generated within the agricultural sector itself. The main lines of technical progress in rice cultivation in this period can be summarised as follows:

i. Improvement and spread of the best known seed varieties combined with the application of increasing amounts of fertiliser. The best-known of these varieties, called shinriki (power of God), was selected by a farmer in 1877. It was highly fertiliser-responsive, and usable over a wide variety of areas, so that it was more widely diffused in Western Japan than any variety

before or since. Commercial organic fertilisers were beginning to meet some of the increased demand which went with the use of better seeds, but in the main it was still met from self-supplied sources within the village.

ii. Improvements in cultivation practices. A number of methods of increasing the yield of a given piece of land and quantity of seed were discovered and/or diffused during this period. These included the selection of the best seeds to plant by soaking them in a salt water solution; the use of improved oblong-shaped seed-beds which made pest control easier; planting out seedlings in straight lines; improvements in methods of pest control. In general, these techniques required much meticulous work and could be thought of as means by which increased labour hours could be translated into increased yields.

iii. Improvements in irrigation and drainage facilities. These made it unnecessary in many areas to leave the field water-logged throughout the winter, and thus permitted double-cropping. They also facilitated the use of animals for ploughing, which was necessary for land preparation if double-cropping was to be practical.

iv. Improvements in tools and implements. The most important of these consisted in advances in the design of ploughs. Combined with the shift from human to animal power, they made deep ploughing possible. Better weeding tools, which speeded up and improved weeding operations, were also developed.

These changes represent advances within four different categories of inputs embodying an agricultural technology. These could be described as: (1) basic infrastruture, (2) tools and equipment, (3) current inputs, and (4) cultivation practices or labour skills. The Meiji Noohoo illustrates the ways in which these elements of an agricultural technology are related to each other in a complementary way, so that a change in one will have a greater effect on output when combined with a change in the others than it would have on its own. The link between infrastructure investment, especially in irrigation and drainage facilities, and the response of output to current inputs (fertilisers and improved seed varieties) in the context of Asian agriculture has been examined in detail by Professor Ishikawa (Ishikawa,12,chapter 2,section 2). The Meiji Noohoo demonstrates this and other links between the components of an agricultural technology. Fig. 2.1 tries to

illustrate these relationships, which may be summarised as follows:

i. Infrastructure investment, in the form of irrigation, drainage and land-reorganisation schemes, made double-cropping possible, and it was often also necessary for the introduction of deep ploughing using animal power, since the fields had to be drained for this. Double-cropping increased the capacity to grow fodder crops for draught animals.

ii. Improved design of ploughs made deep ploughing possible and deep ploughing was essential for full absorption of increased amounts of fertiliser.

iii. More meticulous cultivation practices became profitable when applied to higher yielding seed varieties because the resulting increases in output were significant. This is also true of labour-intensive pest control techniques. Straight-line planting was essential for the use of the new weeding tools.

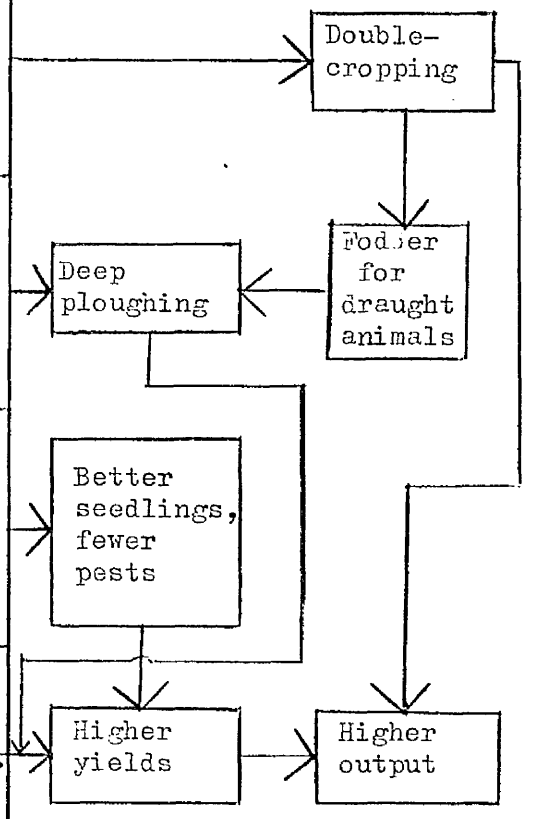
iv. High-yielding seed varieties have their full effect on output only when combined with increased fertiliser input and adequate and controlled water supplies. Therefore, their use is linked to infrastructure investment and deep ploughing.

Thus the Meiji Noohoo was a package, whose total effect was greater than the sum of its parts. The adoption of one aspect of it would tend to induce the adoption of the others. This kind of analysis of the interaction between the components of a technology will be used in describing both the initial and the changed technology of Saga Plain agriculture in relation to the general picture given here.

Technical change during the later stages of the pre-war period largely involved the continued diffusion of these same kinds of technique, though by now the rate was slowing up. The major difference lay in the fact that the inputs required by this kind of change came increasingly to be supplied commercially rather than self-supplied within the village. Cross-bred seeds developed by experiment stations began to take over from varieties selected by farmers. The consumption of commercial organic and later chemical fertiliser expanded. Towards the end of the period, the first steps towards greater mechanisation were being taken in some areas, with the introduction of mechanical threshing machines, electric engines for drainage and irrigation pumps, and, here and there, the power

Fig. 2.1: Technical Complementarities in the Improved Meiji Agricultural Methods (Meiji Noohoo).

Aspect of Technology	Meiji Noohoo	
	Specific Change	Effect
Infrastructure	Land improvement, irrigation, drainage.	
Tools and Equipment	Improved ploughs, weeders.	
Cultivation Methods	Straight-line planting, oblong seed beds, seed selection in salt water.	
Current Inputs	Fertilizers, new seed varieties.	



tiller which was to spread so widely after the war.

3. Links between Technical and Structural Change.

It is only possible at this stage to suggest tentatively the ways in which the story outlined so far can be fitted into the analytical framework of Chapter 1. The purpose of the subsequent study is to try to make the mechanism clearer. In this section, therefore, I shall analyse the process of technical change described in the previous sections in terms of its economic characteristics, and then suggest ways in which these characteristics provide a clue to the explanation of the process of economic and institutional change outlined earlier.

The economic characteristics of pre-war technical change in Japanese agriculture could be summarised as follows:

i. rate of change of output per unit of input. As we have seen, output increase was probably faster in the pre-World War I period than it was in the inter-war period, while input increase may have speeded up. So the overall efficiency of the technology was rising relatively fast in the earlier stages but subsequently less so.

ii. factor bias. The description of the technical changes which occurred suggests that the general trend was for increasing inputs of current capital items, principally fertiliser, and, at least in the early stages, labour input per unit of land. Output growth therefore arose mainly through increases in yields.

iii. divisibility and economies of scale. There is no quantitative evidence that the technical changes of the period resulted in any scale economy effects. They were largely embodied in new forms of input which, to an increasing extent, were produced outside the village economy. But these inputs were, for the most part, highly divisible (seeds, fertilisers) and did not represent a particularly large outlay to the farmer. There are three exceptions to this: (1) draught animals, (2) land improvement, irrigation and drainage facilities, (3) in the later part of the period, mechanical pumps, threshers and hullers. The impact of these inputs is difficult to assess at the macro level, but it seems likely that, on the whole, institutional arrangements were such that the benefits of any scale economies which existed were reaped by most sizes of

farm. Examples of this, and of some exceptions to it (particularly in access to the use of horses) will appear later on.

iv. complexity. Since the changes in technology did not, on the whole, involve the use of machinery, the application of new techniques did not require high levels of education or mechanical skill. New practices could be taught by example. Correct application of fertiliser for the new seeds required a certain amount more learning ability and literacy would clearly be an advantage here. What the new techniques required to an even greater extent was care and patient, diligent labour on the part of the farmer.

Does the available information about economic change in pre-war Japanese agriculture provide any explanation as to why a new technology with characteristics such as these should emerge, or any evidence as to how the change in technology was related to the economic and institutional developments occurring? The data regarding changes in relative factor prices confirm Hayami and Ruttan's hypothesis that the factor bias of the new technology, in terms of its substitution of current inputs for land, can be explained by the fact that the price of fertiliser was declining quite rapidly relative to land prices and rents, as the progress of Japanese industrialisation lowered its production cost. However, it is not so easy to explain trends in the relative use of land and labour in this way. Rents and wages seem to have risen roughly in line with each other until the inter-war period when wages began to rise faster (Ishikawa and Ohkawa,59,appendix chart 3, p.193). If labour input did increase as a result of the adoption of the Meiji Noohoo, then the explanation would have to lie either in the technical complementarities between increased labour input and the use of more current inputs (i.e. in a more complex specification of the economic characteristics of the technology), or in the factors determining the marginal opportunity cost of family labour within the household economy (i.e. in a more detailed analysis of the initial economic conditions). Nor is it possible to explain the emergence of the other characteristics straightforwardly in terms of relative factor prices.

As a first step towards an expanded explanation of the process of technical change, it is possible to put together a sequence of hypothetical links between the characteristics of the

new techniques and changes in economic and social organisation in pre-war Japanese agriculture. This could add to the induced factor bias explanation of the determinants of technical change and help explain the other characteristics and their effects.

We can begin with two sets of facts. Firstly, we know that the initial conditions of Japanese agriculture in 1868 were incompatible with the use of the kinds of large-scale, land-using techniques which represented the most advanced agricultural technology then available. The existing investment in irrigation infrastructure and the scale of farms made the use of large equipment impossible. This was discovered early on after the failure of the new Meiji government's attempts to introduce Western farming methods. This meant that improved technology had to emerge from within the available technological potential (though aided by advances in some scientific fields such as genetics) and as a result of indigenous economic forces.

Secondly, we have evidence that it was from amongst the class of cultivating landlords, the tezukuri jinushi, that the initial innovators of the Meiji Noohoo emerged (Dore,50). Through their leadership of village agricultural organisations, they would have had best access to information about new techniques and to new forms of inputs. They were able to organise land improvement schemes where necessary to the use of new techniques. They were probably relatively well educated and able to experiment and take risks. So it seems likely that it was landowners of this sort who selected and developed the characteristics of the techniques they wanted to adopt and to diffuse to their tenants and other cultivators.

So we could hypothesise that the characteristics of the new techniques developed and diffused in the period before the First World War were the result of the interaction between the initial conditions, especially where embodied in existing investment in land improvements, and the economic forces, including the buoyant market for rice, operating on landowners of the tezukuri jinushi type. The characteristics of the Meiji Noohoo appealed to these landowners because: (1) they offered quite rapid increases in yields on cultivated land while fitting reasonably well into the existing economic and technical structure (although involving a certain amount of investment in land improvement); (2) the inputs required were available to them at relatively low cost - current inputs were

becoming relatively cheap and it was still possible to draw on supplies of labour from within the household and from other households, both through ties of obligation and through hiring; (3) the divisibility and lack of complexity of the new techniques meant that they could, with a certain amount of persuasion and teaching, be diffused to tenants and other farmers within the village - this benefitted the tezukuri jinushi from an economic point of view, through possible higher and certainly more stable levels of rents on the land they leased out, and perhaps from a social and psychological point of view, given the nature of their role as village leaders (Ishikawa,58).

The characteristics of the Meiji Noohoo thus emerged, as the larger-scale landowners selected and improved available techniques, aided by the government's research and extension organisation, the itinerant lecturers and so on, with which they had contact. In their turn, the new techniques affected social and economic organisation. The initial adoption of yield-increasing techniques by larger-scale landowners enabled them to acquire ownership of the land of smaller-scale farmers, struggling with the increasingly commercial economy and unable as yet to adopt new techniques.

However, as outside economic conditions changed around the time of the First World War - as sources of labour supply outside the household became harder to find, as wages rose relative to rents, as tenants became better educated and socially stronger - and as improved techniques spread from larger to smaller-scale cultivators, the ultimate effect of the characteristics of the Meiji Noohoo may have been to increase the relative efficiency of the small- to medium-scale farmer. Such a farmer's family labour supply was probably adequate for the needs of his holding and motivated to carry out new cultivation practices meticulously. Such farmers, especially after the First World War boom in agricultural prices, had become sufficiently entrenched in the commercial economy to be able to buy new inputs from it and to sell more output to it. They were now, educationally and socially, able to become involved in the agricultural organisations which promoted new techniques. So, by this time, they were perhaps better able than the larger-scale cultivator to benefit from the characteristics of the Meiji Noohoo.

The increasing diffusion of new techniques and of the ability to innovate among small- to medium-scale farmers can then be

seen as related to subsequent changes in the economic and social organisation of agriculture between the wars, in particular to the increasing concentration in the middle ranges of the size scale of cultivated holdings. The rising relative efficiency of smaller-scale farmers with the new technology would, in the first place, have strengthened their economic position vis-a-vis larger cultivators. Wataya has some evidence that the middle-scale owner/tenant group had higher land and labour productivities and invested more in inputs per hectare during the inter-war period than did those above or below them in the size distribution (Wataya,80). Secondly, this divergence in productivity levels would have encouraged larger farmers to rent out their land rather than cultivate it themselves, and would thus have strengthened the trend towards absentee landlordism, intensified the decline of the tezukuri jinushi, and made land available to those rising up the size scale. Ohkawa has shown theoretically that it is divergences in yields between larger and smaller farms (resulting from varying levels of labour input per hectare) that induce larger landowners to rent out their land rather than cultivate it themselves (Ohkawa,22,pp.277-292). Thirdly, as the potential of the family labour force became exhausted and the rate of growth and technical progress slowed up in the inter-war period, the first steps were taken towards forms of mechanisation which could ease labour constraints within the context of the small- to medium-scale family farm. It is thought that, by this time, it was from the group of middle-scale owner/tenants that the initial innovators came and that it was the economic forces operating on them which influenced the development of mechanical threshers, hullers, pumps and ultimately the power tiller, towards the end of the inter-war period (Ishikawa and Ohkawa,59,p.172). Thus, coming round full circle, the results of the adoption and spread of the Meiji Noohoo themselves influenced the direction of the next stage of technical progress.

The particular case dealt with in this study did not follow this pattern exactly because it was influenced by the peculiarities of the natural and economic environment of the area. It does not, therefore, provide evidence of general trends, but rather of the existence of the hypothesised interactions between changes in technology and changes in economic and social organisation. It does this by trying to reveal the mechanisms whereby such

interactions operated within the Japanese context. It therefore looks at the micro-economic roles played in the process of technical change by Japanese institutional mechanisms such as the group organisation of investment in new techniques and the official institutions which helped develop and select the characteristics of new techniques.

A Note on Data Sources.

The information on which the following study is based derives from two types of source. A certain amount of basic statistical data can be assembled from the relatively accessible Saga Prefecture Statistical Yearbook (Saga-ken Tookei Sho). The major series go back to 1888 and are broken down to county (gun) level. For the agricultural sector, they cover subjects such as the labour force, cultivated area, output, and so on, along with some less comprehensive data on institutional organisation, such as the scope of tenancy and the size structure of holdings. However, the much more important sources for the present study are secondary ones - the works of agricultural economists and historians who have gathered together information from a wide range of primary sources.

A major problem for present purposes with the prefectural statistical data is their geographical coverage. The Saga Plain is a distinct area from the point of view of its natural environment. The prefecture contains, in the south, other plain areas more recently reclaimed from the sea, and, in the north and west, hilly areas. Both of these differ in natural conditions and agricultural technology from the area known as the Saga Plain. However, administrative boundaries do not co-incide with these environmental differences. Although the Saga Plain lies entirely within the jurisdiction of Saga Prefecture, it falls into several of the administrative sub-divisions of the prefecture called gun (county) and shi (city). Most of it lies within Saga and Kamisaki counties and Saga city, but parts of it stretch into two other counties of the prefecture (see Map 2).

To deal with this problem, data for Saga-gun have been used to represent the Plain in the present study, where they are available in the Yearbook. Other sources sometimes use other areas (e.g. Saga-gun + Saga-shi) and, where nothing more detailed exists, data for the whole prefecture are presented. Saga-gun covers about 13,000 ha. of cultivated land and Saga- and Kamisaki-gun together with Saga-shi cover about 20,000 ha., that is to say, about a quarter of the approximately 70,000 ha. of cultivated land in the whole prefecture. Inclusion of the two part-Plain counties puts the proportion up to almost 50% of the cultivated area. In the pre-war period, about 30% of the value of all agricultural output of the

prefecture was produced in Saga- and Kamisaki-gun and Saga-shi, about 50% if the two other counties are included. These proportions are roughly the same for rice output. Saga-gun alone produced about a quarter of the prefecture's rice. The Plain was the most important agricultural area of the prefecture and, as can be seen, must have exerted a considerable influence on the overall trends. But this influence is diluted and complicated by the, at times unavoidable, inclusion in the data of other parts of the prefecture whose experience was somewhat different.

Turning to the secondary sources, there exists quite a long history of studies of Saga Plain agriculture. Work on the available official data had begun before the Second World War and Tanaka had already produced a famous analytical study, based on surveys of individual villages (Tanaka,42 and 79). Kamagata's book (Kamagata, 34), published in 1946, is the earliest of the large-scale sources used for the present study. It draws heavily on official surveys, documents, regulations, and so on, and on the records of research and extension workers in the Saga Prefecture Experiment Station. These are put together to make a descriptive history of changes in agricultural techniques in Saga. Dr. Isobe's long article (Isobe,76) is a more analytic work, written as part of a collection of studies of regional aspects of Japan's agricultural development. He draws on previous work, such as Kamagata's, but also makes considerable use of regional breakdowns of national surveys and locally collected official statistics. Yamada and Oota, in their large-scale history of agriculture in Saga Prefecture (Yamada and Oota, 46), use similar sources, but, being local agricultural historians devoting lifetimes to the collection of materials about the Saga area, they are able to draw on local records and documents, even down to the level of individual households. Dr. Miyajima is a research officer at the Saga Experiment Station, and his book (Miyajima,36) is a somewhat more popular account of the development of new techniques in Saga. It is written rather as the story of the work of the Experiment Station and so gives a more vivid and detailed account of the way research workers actually went about developing and diffusing new techniques.

In general, the primary sources used in these and other works referred to in the study could be summarised as follows:

i. Regional data collected for the purposes of national

surveys, e.g. the 1940 Tekisei Kiboo Choosa (Survey of Appropriate Scales of Farm).

ii. Surveys and reports made by official institutions at the local level, particularly the Experiment Station, local government departments and the prefectural agricultural association, e.g. the Experiment Station's 1915 survey of seed varieties used in Saga Prefecture.

iii. The work of individual agricultural economists working in local research organizations, such as the Saga Prefecture Agricultural Labour Research Institute, the agricultural economics departments of Saga and of Kyuushuu Universities.

iv. Local records made by individual farms, villages, co-operatives, etc., e.g. the records of the Oide Irrigation Association.

Further reference to the nature of sources will be made where appropriate in the detailed description of events in the Saga Plain area, which now follows.

CHAPTER 3

The Initial Conditions of the Saga Plain Area.

The first component of the framework of analysis developed in Chapter 1 was the concept of the initial conditions. This chapter aims to examine this concept as it operated in the case of the Saga Plain area. It seeks to isolate and describe the various factors making up the initial conditions, as listed in Chapter 1. As was argued then, we need to appreciate the interlocking technical and economic systems of the initial conditions period in order to understand the effects both of the coming of market relationships to the village from outside and of technical changes within the production system.

The technical and economic organisation described here is broadly that in existence on the Saga Plain throughout the nineteenth century. The major components of that system were in operation long before this, but for present purposes the relevant economic and technical relationships were those in existence around the time of the Meiji Restoration in 1868. These represent the distillation of the results of the long experience of agricultural conditions during the slowly-changing Tokugawa period of Japanese history. The final section of the chapter, however, deals with the response of Saga farmers to the new techniques which became available during the Meiji period.

1. Technology and Resource Endowments.

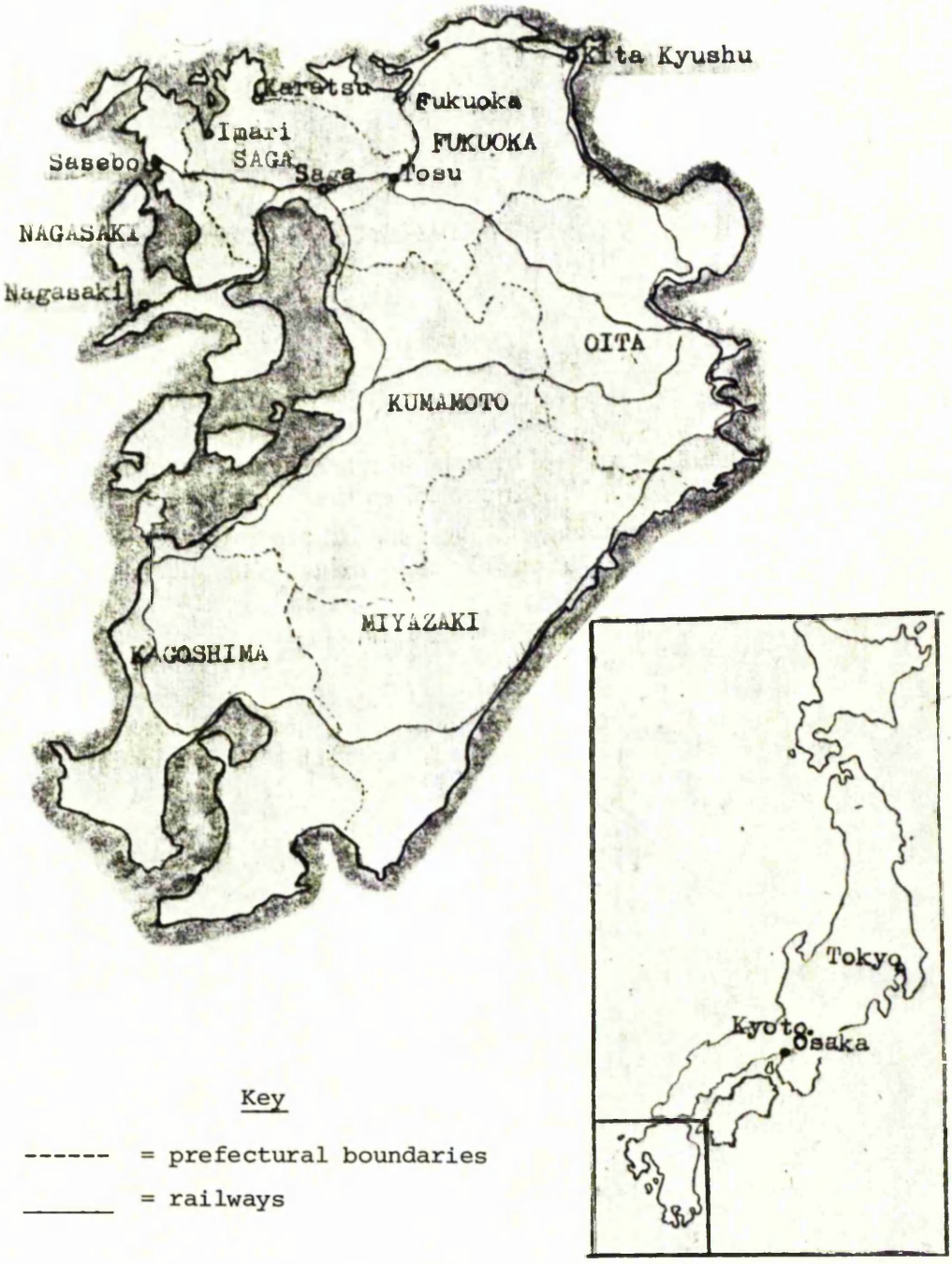
(i) environmental conditions.

Saga Prefecture lies in the north-western corner of the island of Kyuushuu (see Map 1). To its North lies the Sea of Japan, and in the South it reaches down to the Ariake Sea, a large bay protected from the open ocean by the curved peninsula of Nagasaki Prefecture. To its East and West lie mountain ranges, separating it from Fukuoka and Nagasaki Prefectures. Its north-western area is hilly, but drops down to a coastline of sandy beaches, small holiday resorts and fishing harbours, reaching from the port of Imari, long famous for its pottery-ware, in the West, to the fishing port of Karatsu in the

Map 1.

KYUUSHUU

(1 : 2,250,000)



Key

------ = prefectural boundaries

_____ = railways

East. Along its south-eastern border with Fukuoka Prefecture flows the river Chikugo, and westwards and northwards from this river stretches its alluvial plain, surrounded by mountains away to the North and East, and reaching down to the sea in the South (see Map 2).

The alluvial plain of the Chikugo covers a wide area of land over which the natural environment varies toward the sea and the mountains. It is the central part of this plain, an area of about 20,000 ha. of reasonably homogeneous natural conditions, which is known as the Saga Plain and is the subject of this study.

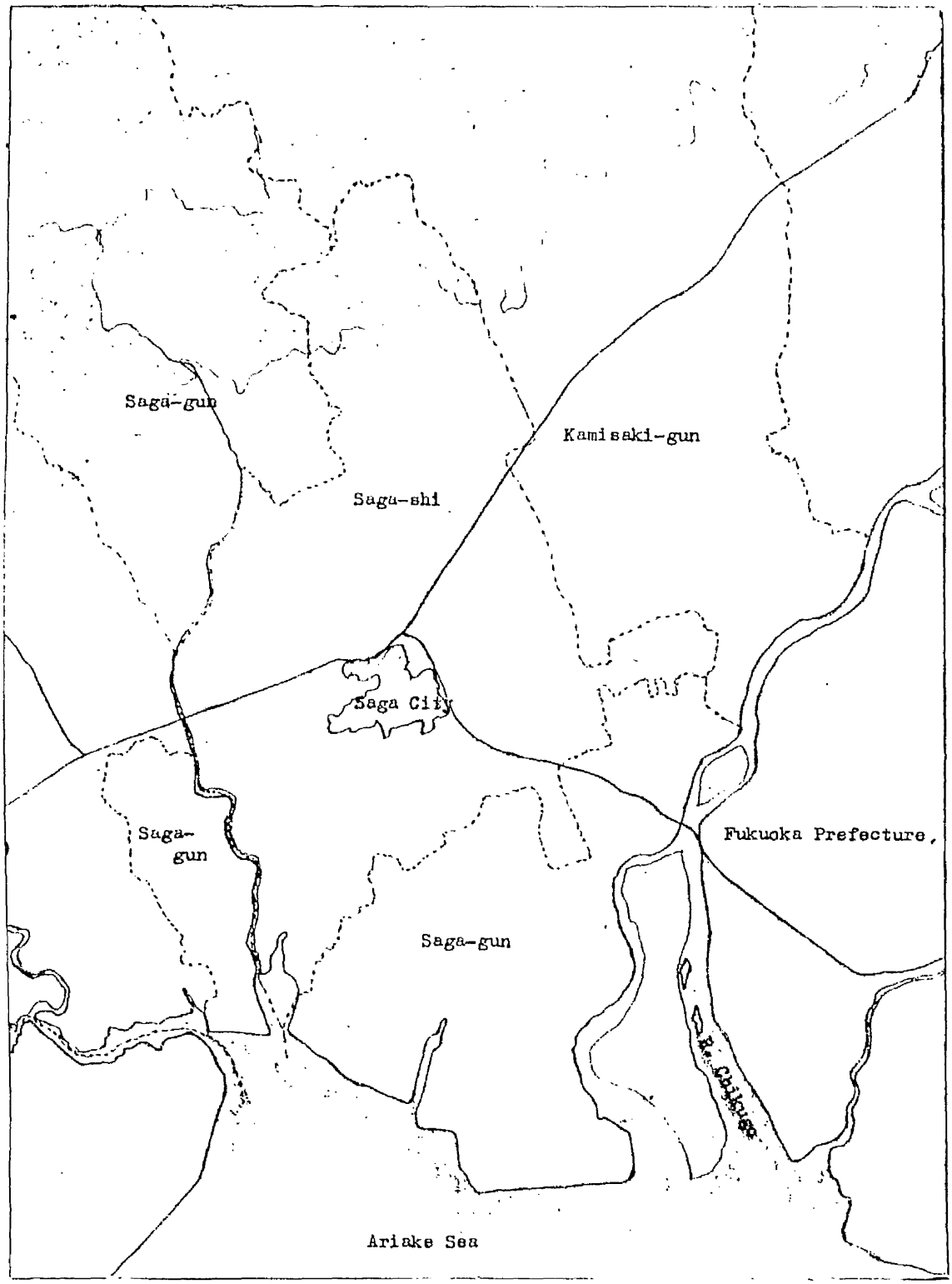
The most crucial environmental feature of the Saga Plain, from the point of view of paddy rice cultivation, is its flatness. The centre of the Plain is no more than 3 metres above sea level. Its landscape, a wide, flat, green expanse with the distant mountains apparent only as shadows on the horizon, appears less unfamiliar to the western observer than does the more typical landscape of Japanese agriculture, with its narrow coastal plains and terraced hillsides. Considerable amounts of reclamation and drainage work were a pre-condition for agriculture on such a flat plain. This process has continued from the beginnings of agriculture in the area until the present day, but the bulk of what is known as the Saga Plain was made cultivable during the Tokugawa period. As compared with other parts of the Chikugo basin, it is a relatively old-established area.

Being an alluvial plain, the soil of the area is rich and fertile. The climate is also favourable to grain cultivation, with long sunny summers and relatively mild winters. However, the soil is heavy and difficult to work and, although it holds water and fertiliser well, good ploughing and land preparation are hard to achieve without a horse or some other source of power. The area is also subject to storms and heavy rain which lead to flooding on the flat land. But despite these problems, soil and climate are, by and large, favourable to rice cultivation and, indeed, to high yields. Furthermore, a much larger proportion of the cultivated area is suitable for paddy cultivation in Saga than in the rest of the country, where many fields are too high up the hillsides to be reached by the flow of irrigation water. 85-90% of the cultivated area of Saga County is and was paddy land, compared with about 70% in Saga Prefecture and a little over half in the country as a whole (SKTS,86 and LTES,84).

Nevertheless, although the environment was in the above

Map 2

THE SAGA PLAIN (1 : 111,000)



land over 100m. above sea level

——— railways

..... gun boundaries

respects well suited to rice cultivation, it presented two severe problems which Saga farmers had to overcome. The first was the supply of irrigation water to the fields.

Typical methods of irrigation in Japan involve the use of the slope of the land which the generally mountainous nature of the country's geography provides. Water is collected in reservoirs or ponds or is held behind dams in the upper reaches of rivers. When it is needed it is allowed to flow down into the fields and through the interconnected paddies by utilising the slope of the land and the various levels of the fields.

Such a system is impossible on the Saga Plain, and in response to this environmental problem, a rather different system of irrigation grew up there as land was reclaimed and made cultivable. As paddies were constructed, ditches were dug to drain away water into the more-or-less distant rivers. As the rivers rise in the spring, and as rainwater collects, these ditches fill up with water which can be used to irrigate the paddy. Thus, all over the Plain, there exists a network of interconnected ditches in which water collects (see Map 3). These ditches are somewhat larger than the usual irrigation channels to be observed in Japan, being anything from six feet upwards in width. This is the result of the fact that their function is also different in that they are required to store water, in place of ponds or reservoirs, as well as bring it to the field. They are known in all the Japanese literature by the English word "creek". Their overgrown banks, making bright green lines across the flat fields, make them the distinctive feature of the landscape. As sources of water for the home as well as the farm, even as a means of communication, they have played a vital role in the life of the Saga villages.

Creek irrigation is to be found in some other areas of Japan besides Saga. It is practised, for example, on the opposite bank of the Chikugo River in Fukuoka Prefecture. It is not possible to disaggregate the data so as to discover what proportion of the paddy area of Japan was irrigated from creeks during the period with which we are concerned, but it must have been small. Creek irrigation presented severe technical problems and was only practised where environmental conditions made it absolutely unavoidable, that is where there was no slope or flow to force water on to the fields.

The most important of the difficulties faced by farmers

Map 3 (overleaf)

THE CREEK NETWORK

Source: Detail of the Japanese equivalent of an Ordnance Survey map (1 : 25,000), covering the Saga Plain area (1967).

Notes: The built-up area in the top left-hand corner is part of Saga City. The river Chikugo is shown in the bottom right-hand corner. The road and railway run diagonally across from top left to bottom right. The shaded streams are creeks enclosing the paddy fields.

in creek irrigation areas was that there water had to be lifted, using some power source, and transferred from creek to field. The technology therefore had to embody some means of lifting water. This was unnecessary in most kinds of environment found in Japan, at least as a permanent feature, since water would simply flow into the fields. It conditioned, as we shall see, the whole technical and economic system in use on the Plain.

The second major problem presented by the environment was that of pest damage. The Chikugo basin provided ideal conditions for an insect called the Sankameichuu or Three-brooded Rice-borer. Relatives of this pest were common throughout Japan. As moths (the Pearl Moth), they layed eggs amongst rice seedlings. The larvae hatched out and lived on the stems of the growing rice plants, causing severe damage. The variety of this insect prevalent in Saga was able, under the conditions there, to go through three life-cycles in a year. It could therefore cause more severe harvest loss than its single- or two-brooded relatives. 20-30% losses were not uncommon and in the disastrous year of 1893, the prefecture's harvest, which usually averaged about 120,000 tonnes at this time, was reduced to 51,000 tonnes by rice-borer damage (SKTS,86). The risks involved in rice cultivation were therefore greater in Saga than they were elsewhere in Japan, and this fact also, as we shall see, conditioned the technology used in highly significant ways.

To summarise, the natural environment of the Saga Plain provided farmers with potentially very good conditions for grain cultivation. But it presented two major problems which made the application of the basic cultivation techniques of Japanese agriculture difficult. The first of these was the problem of supplying irrigation water to the paddy field, and the second was the high risk resulting from the prevalence of the rice-borer.

(ii) technology

It was argued in Chapter 1 that the technology in use in an agricultural area during the initial conditions period will be uniquely adapted, by long experience, to the resource endowments of that area. It was also suggested that, alongside this, there would be technologically complementary relationships amongst the various processes making up the whole production system. In the previous section the major environmental peculiarities of the

Saga Plain area were outlined. The aim of this section is to illustrate the ways in which the technology in use was adapted to this environment and to describe the interlocking technical relationships embodied in the production system.

To begin with the problem of supplying irrigation water, we have seen how the network of creeks covered the Plain bringing water to every paddy field. Each field adjoined a creek from which water could be drawn onto it. The simplest method of doing this was simply to lift water in buckets and throw it on the fields, and this was the technique used from the earliest days of agriculture on the Plain until around the 1770s and 80s. At this time, the bucket method was superceded by the use of treadle-wheels which quickly spread over the Plain and were used almost universally there until the 1920s.

Treadle-wheel irrigation was central to the technical system in operation during the initial conditions period. The wheels were made of wood, criss-crossed with a complex arrangement of spokes, and were about 5 feet in diameter (Fig. 3.1). They were designed to be turned by one person, treading on the slats of the revolving wheel and balancing himself on long poles. At least one wheel was an essential item of capital equipment for all Saga Plain farmers. Often, where water had to be raised some distance from creek to field, two or three wheels were operated in sequence. Treadle wheels were used elsewhere as supplementary means of irrigation, but perennial reliance on them for raising water onto the fields was peculiar to creek areas.

The work involved in using the treadle wheel was long and very hard. According to Miyajima, it was backbreaking and demoralising. It wore callouses on the feet and ultimately ruined the health (Miyajima, 36,p.15). The meaning that the wheels held for the farmers of the Saga Plain is indicated by the fact that they are still to be seen, 50 years after going out of use, employed as the equivalents of pub and shop signs, even decorating the foyer of a hotel. They were not just pieces of equipment but symbols of the gruelling work which Saga people had to perform in order to grow rice in their environment.

From the economic point of view, the most important difference between the use of the treadle-wheel and more typical Japanese irrigation methods lay in the labour requirements per

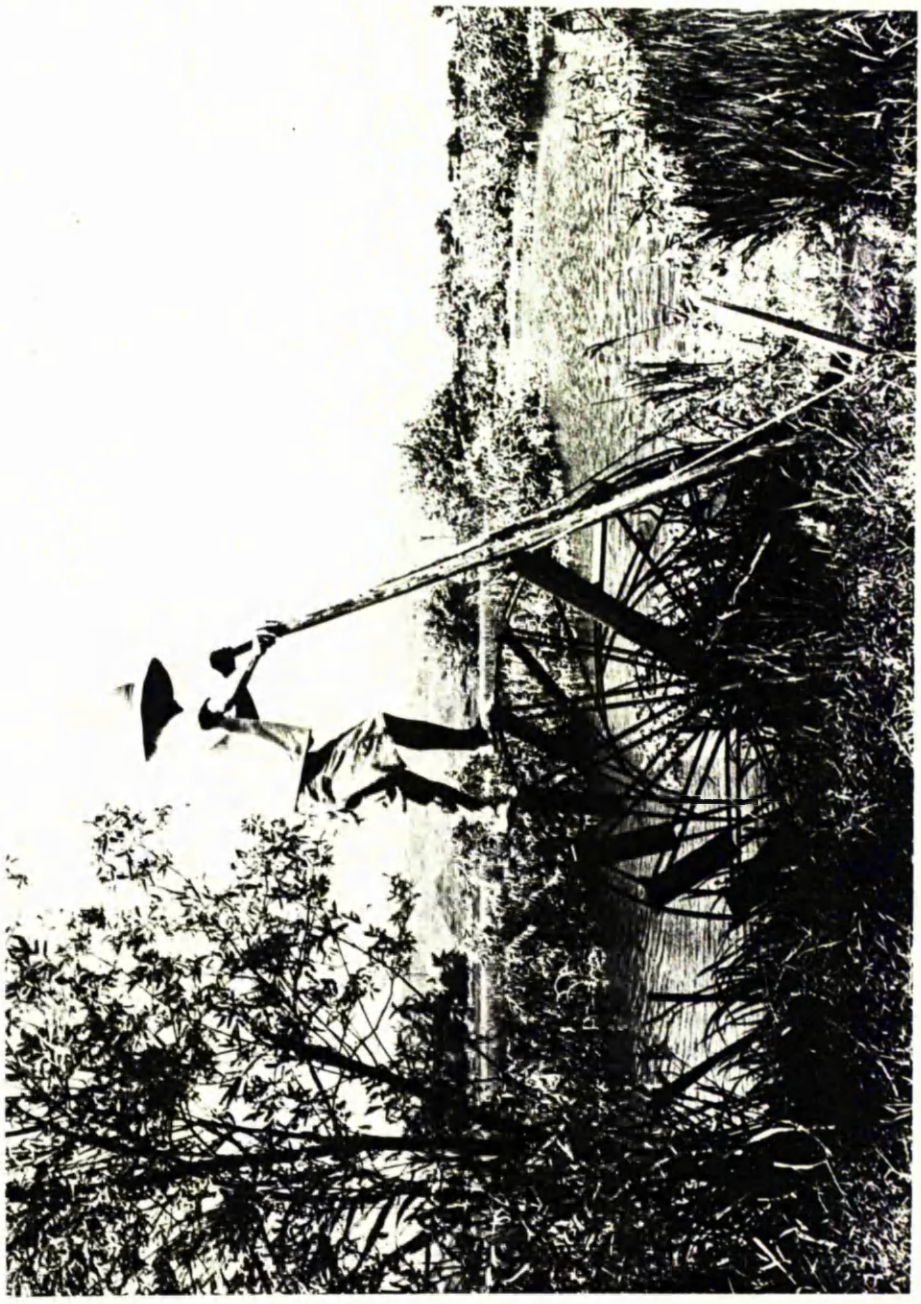


Fig. 3.1

A TREADLE-WHEEL IN OPERATION.

hectare which it demanded. Although treadle-wheels were an advance on buckets, they still required man's labour for days on end throughout the spring and summer. They meant that one man could manage only about 40 ares of land when the average size of holding was over 1 hectare (Isobe,76,p.15). Where two or three wheels were necessary, the major part of a family's labour force would be tied up with pumping during the busiest months of the farmer's year, when numerous other operations needed to be carried out.

The labour requirements of treadle-wheel irrigation exerted, as we shall see, a profound influence over the economic system of Saga Plain agriculture for two reasons. Firstly, they created pressure to try to spread out the labour demands of the irrigation technology over as long a period as possible in order for a family to be able to cultivate a reasonable area. Secondly, they meant that, even with labour demand spread out, the average family did not possess enough labour to farm a holding of average size or upwards. The need to mitigate the effects of these two facts led, as we shall see, to adaptive adjustment both within the technology and in the economic and social relationships between households.

In addition to the difficulties of irrigation there was also the problem of the rice-borer. At this stage, very little was known about the life-cycle and habits of the insect. As far as the farmers were concerned, the occurrence of rice-borer damage was an act of God, against which they were more-or-less powerless. The only control technique known was the holding of torchlit processions through the fields, luring the moths away to the sea or the mountains (Kyuushuu Noosei Kyoku,35,p.239). This was not an entirely ineffective method as the farmers recognised, reciting sutras for the souls of the moths they had thus destroyed. But its effect was not great enough to stop the farmers from inferring that the size of the harvest depended on whether or not the rice-borer struck, rather than on the agricultural techniques used.

In this situation, one of the farmers' main concerns was to minimise the risk of severe harvest loss. His other concern, as we have seen, lay in spreading out the labour demands of the irrigation technology over as long a period as possible. The combined result of these two concerns was the development of an unusual crop rotation system, which was well established during the

initial conditions period. The majority of the cultivated area of the Plain being converted into paddy fields, rice was obviously the most important crop grown in this rotation. But farmers whose land could be drained when necessary and who had access to sufficient labour and horse power were able to grow winter crops of wheat, barley, and other grains, or vegetables. In 1888, for instance, the second grain crops absorbed 21% of the total labour days in agriculture in Saga Prefecture, and produced 18% of the total harvest (Isobe,76,Table 6,p.9). But the principles of the rotation set out below, designed as it was with the aim of reducing the risk of rice-borer damage and spreading out the labour requirements, were applied by all farmers, whether or not they grew second crops.

The characteristic feature of this rotation was that it involved the farmer in dividing his land into two sections, usually in the proportion 60:40. Each was planted with rice at a different time during the spring. Different rice varieties, suitable for early or late planting, were used in each section. The rice growing in each of the two sections was thus always at a different stage of its growth. The basic form of the rotation and its phasing system are set out in Fig. 3.2.

This rotation produced two results. Firstly, each operation of the cultivation process could be performed at a different time on each section. Most significantly, it was not necessary to pump water on to both sections at the same time. This therefore increased the area which, during the course of a year, one man's labour could irrigate. Secondly, with the rice in each section at different stages, it was not likely that, if the rice-borer struck, it would affect both sections with equal severity. The risk of heavy loss was therefore reduced. The rotation thus served to adapt the technology both to the available endowments of land and labour and to the peculiar features of the natural environment.

There were other ways also in which the technology was adapted to the demands of the natural environment. These were principally to do with land preparation. The human effort required to raise water on to the field made such water very precious, and everything possible was done to preserve it in the field and minimise leakage. Ploughing techniques were specially adapted so as to create a kind of base to the soil in the paddy through which

Fig. 3.2

TYPICAL ROTATION IN OPERATION ON THE SAGA PLAIN DURING THE INITIAL CONDITIONS PERIOD.

	Section 1	Section 2
April	Rice Planting (early varieties)	
May		Rice Planting (late varieties)
June	Transplanting	
July		Transplanting
August		
September	Harvesting	
October		
November	Winter Crop (eg. wheat, rapeseed, broad beans)	Harvesting
December		
January		Fallow
February		
March		
April		Rice Planting (early varieties)
May	Rice Planting (late varieties)	
June		Transplanting
July	Transplanting	
August		
September		Harvesting
October		
November	Harvesting	
December		Winter Crop
January	Fallow	
February		
March		

Source: Adapted from Isobe,76,p.12.

water could not leak. The field needed to be ploughed many times and for the final ploughing a special kind of plough was used, designed to form this base to the field. This final ploughing was called "tokojime" and required considerable skill on the part of the ploughman. If it was not carried out well, the farmer could wake up in the morning to find that all the water had leaked from his field, that he was the laughing-stock of the village and was faced with the unbearable task of pumping the water back again (Miyajima,36,pp.18-19).

The complete ploughing system made further heavy demands on the capital and labour resources of the farmers. Many hours of skilled labour were called for, in the autumn as well as the spring if a second crop was to be grown. A complement of three different kinds of plough was necessary. Above all, such ploughing was greatly facilitated by the use of a horse. Horse-ploughing was by no means standard practice in Japan at this time, and ploughing using human labour was still common. But the use of horses had originated in Kyuushuu and was widespread on the Saga Plain by the end of the Tokugawa period. The heavy capital requirements of these cultivation methods combined with the economics of horse ownership to necessitate the development of particular economic relationships between households.

One final way in which technology was adapted to environment might also be mentioned. In Tokugawa Japan the most common source of agricultural fertiliser was leaves and grass collected in upland areas owned by the village community. On the Saga Plain there were no upland areas but the natural environment provided an excellent substitute in the mud which was carried down and deposited in the creeks by the flow of water from the rivers. In the winter, during the phases of the crop rotation when land lay fallow, groups of farmers would lift mud from the bottoms of the empty creeks, standing chest deep in the icy mud, using buckets and pulleys to transfer it onto the field. There was no escaping this unpleasant job since, besides providing fertiliser, it was essential if the creeks were not to silt up and it thus formed an integral part of the technical system.

Aside from the peculiarities of irrigation methods, rotations and land preparation, actual rice cultivation techniques resembled those typical throughout Japan. Seedlings were grown in seed beds from numerous local varieties of seeds and transplanted into the prepared and fertilised paddy-field. Water stood in the

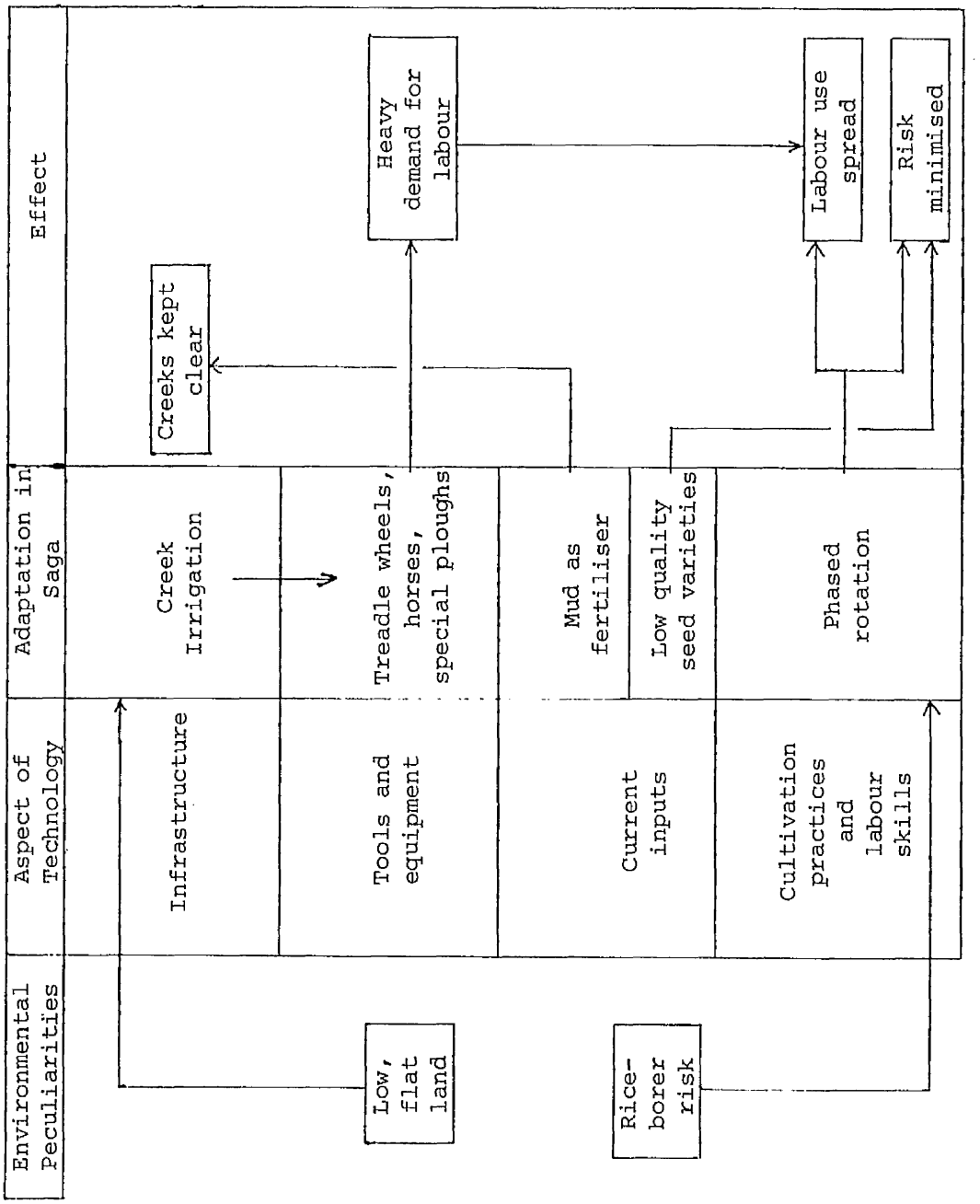
field during the three to four month growing period of the plants. Enthusiasts weeded their fields anything up to five times, by hand or with a hoe. The grain was harvested by hand and threshed, using a simple wooden tool.

To summarise, then, the technology in use on the Saga Plain during the initial conditions period represented an adaptation of standard cultivation techniques to the natural conditions and factor endowments of the area. The links between the various parts of the resulting technology, and the differences between it and the more typical technology described in the previous chapter, are illustrated in Fig. 3.3, which uses the same format as Fig. 2.1. The irrigation method embodied both in infrastructure and in water-raising equipment was a response to the flatness of the environment. Cultivation practices were a response to the risk posed by the rice-borer, both through the rotation and through the use of relatively inexpensive current inputs (e.g. low-quality seed varieties). The irrigation method, together with the ploughing techniques it necessitated, created heavy peak labour and capital demands, which could only be accomodated within the framework of the special rotation, which simultaneously minimised rice-borer risk. It also made double-cropping feasible. The rotation included the fallow period necessary for the clearing from the creeks of the mud used as fertiliser. The result of all these interconnections between aspects of the technology was that fundamental change was impossible unless both major environmental problems were solved simultaneously.

The next step is to consider how the economic structures of villages and households were adapted to the demands of this technology. For this purpose it might be useful to summarise the factor requirements of the technology. Essentially, the demands for labour, and to some extent capital, per unit of land were made unusually heavy by the necessary technological adaptations. Although this was mitigated by the lengthening of the growing season involved in the rotation, it remained true that labour requirements per hectare over the spring and summer were unusually heavy and that therefore the area of land which one family could manage with its own labour was less than that in areas where technology was more typical. This is reflected in the fact that cultivated area per worker on the

Fig. 3.3

THE INITIAL TECHNOLOGY OF SAGA PLAIN AGRICULTURE,
showing the interconnections between aspects of the technology
in spreading out labour demand and minimising risk.



Plain was unusually low. During the 1890s, for instance, it stood at about 22-24 ares per man compared with a national average of around 35 (SKTS,86, and LTES,84). But we are now moving away from purely technological considerations and must turn to considering the economic relationships which were built onto this technology.

2. The Distribution of Productive Assets among Households.

The most important resource to consider here is land, the principal basis of economic, political and social power in most agricultural societies. This section will deal first with the distribution of land ownership and the structure of land use. It will then show how the pattern which emerges from this was re-inforced by variations in the quality of land owned and used, and by the distribution of capital assets.

(i) land.

In Saga, as elsewhere in Japan, the distribution of land ownership and the tenancy system contained every gradation of holding type, from the smallest tenant farmer up to the very large landowner, although it must not be forgotten that, in the Japanese context, someone owning 5 ha. was a very large-scale landowner, and the majority of households cultivated holdings of less than a hectare. There is little statistical data for the initial conditions period, so it is difficult to go beyond this general picture except in terms of qualitative impressions and deductions. On this basis, the structure of land ownership and use on the Saga Plain could be characterised as follows:

i. In terms of landownership, there were heavy concentrations of households in the smallest categories of the size distribution and a relatively high proportion of medium- and upper medium-sized landowners, but a smaller proportion of very large-scale landowners than was typical for the country as a whole.

ii. In terms of the size distribution of cultivated holdings, there was similarly a large proportion of very small-scale cultivators, and a relatively large proportion of upper middle-scale cultivators, but very few large-scale farms.

The reasoning behind this characterisation is as follows:

i. There is scattered statistical evidence to suggest

that a high proportion of households owned very small areas (e.g. less than ½ ha.) and a very small proportion owned anything over 3 ha.. Table 3.1 shows some data on the size distribution of landownership in the early Meiji period, collected from records kept in individual villages.

ii. The policy of the government of Saga prior to the Meiji Restoration had tended to stifle the development of large-scale landownership (1). Towards the end of the Tokugawa period, the feudal lords who governed local areas were falling into increasing financial difficulties. The rulers of Saga were in a particularly difficult situation because they were called upon to provide ships for the defence of the country. Saga being an agricultural area with no large urban centres, there were few businessmen or merchants who could be taxed or who could lend money to the government. The Saga clan therefore depended on income from agriculture and took a considerable interest in the prosperity of the farmers. Irrigation work, for instance, was often organised by the clan government. As the rule of the Tokugawa government began to break down in the mid-nineteenth century, however, and as commercial relationships (especially tenancy) began to break into the village economy, it was felt that some more drastic measures were needed to preserve the welfare (and tax-paying capacity) of the farmer.

What resulted can only be described as a land reform, aimed at halting the development of absentee landlordism. In 1842 an order was issued postponing the payment of all rent and interest for ten years. The period was extended in 1852, but the protests of landlords made it necessary to come to a permanent arrangement and in 1861 regulations were issued for dividing the land of non-resident landowners in fixed proportions between landlord and tenant. The effect was to confiscate the land of non-resident landholders and place a ceiling of six ha. on the land holdings of resident landlords and cultivators. This high ceiling, along with various exceptions applicable to newly-reclaimed land, meant that the amount of land handed over to cultivators was only about 3% of the cultivated area of present-day Saga Prefecture. But it tended to slow down the development of large-scale landowning and strengthen the

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(1) The following is based on the description given in Saga-ken Noochi Kaikaku Shi Hensan Iinkai,41, chapter 8, section 3.

Table 3.1

SIZE DISTRIBUTION OF LAND OWNERSHIP IN A GROUP OF SAGA PLAIN VILLAGES.

A. At the beginning of the Meiji period.

	Under 0.3ha	0.3 - 0.5ha	0.5 - 1.0ha	1.0 - 1.5ha	1.5 - 2.0ha	2.0 - 3.0ha	Over 3.0ha	Total
Number of Households	49	75	91	52	23	18	3	411
Percentage	36.2	18.2	22.1	12.6	5.9	4.3	0.7	100

B. In 1881.

	Under 0.3ha	0.3 - 0.5ha	0.5 - 1.0ha	1.0 - 1.5ha	1.5 - 2.0ha	2.0 - 3.0ha	Over 3.0ha	Total
Number of Households	150	18	38	37	27	13	5	288
Percentage	52.0	6.3	13.2	12.9	9.4	4.5	1.7	100

Source: Yamada and Oota, 46, pp. 271 and 288.

N.B. Some villages appear in both parts of the Table, but some different ones are also covered each time.

position of the small-scale farmer at precisely the time when the tendency for small farmers to fall into tenancy to large-scale landlords was setting in elsewhere in the country. The protests of the small-scale farmers of Saga were sufficient to prevent the Meiji government, when it came to power in 1868, from carrying out its aim of returning the confiscated land to its former owners.

iii. The characteristics of the technology would tend to imply this kind of a structure. These would, firstly, tend to make cultivation on a large scale difficult. Large-scale cultivation has always been difficult and rare in Japan (excluding Hokkaidoo). In a situation in which the layout of plots is largely determined by the irrigation system and in which any one farmer's plots are scattered throughout the village land, a large cultivator is simply one who owns more by-and-large identical plots than other people. There are, therefore, few scale economies to be obtained from farming a large number of plots. With the technology in operation on the Saga Plain, large-scale cultivation was made even more difficult because the larger the area a household farmed, the more labour it had to find from outside the family. The skill and care demanded by Japanese rice cultivation techniques make the management of a large labour force for efficient cultivation difficult. For these reasons cultivation by one household of an area greater than about 3 hectares was rare. Secondly, the characteristics of the technology would have tended to keep a higher-than-average proportion of farmers at the lowest end of the size distribution. The small-scale farmer could manage his holding with his family's labour and borrowed equipment and horse power. As a holding became larger, this would become increasingly difficult and the household would begin to need to acquire its own ploughs, its own horse and so on. When we come to consider the household economy of the small farmer we shall see that he would rarely be in a position to accumulate the capital necessary to make the shift into larger-scale farming.

The structure which emerges from this view of the influences on the distribution of land ownership and use in the Meiji period is thus one consisting of, on the one hand, a group of medium- to large-scale cultivators and landowners, and, on the other, a much larger group of very small-scale cultivators of owned or rented land. The available evidence suggests that about a third of

households farmed enough land to put them into the first group, with the remaining two-thirds mostly to be found in the second group (Kamagata,34,p.182).

(ii) land quality.

Land quality on the Saga Plain was largely a question of the ease with which a field could be irrigated and drained. The most valuable fields were those which could be drained in the winter and those where the distance between field level and creek was small. Also, although all fields adjoined a creek, the right to raise mud from a given creek belonged to the owner of a particular field. So fields that brought with them this right were more valuable than others. It is likely, in the light of our knowledge of the ways in which Japanese villages developed, that it was the larger landowning households which owned the most valuable fields (1). They were likely to be the households of the main village families, descended from the original inhabitants of the village, and therefore original owners of the land farmed by their branch households and by other families initially dependent on them (2). They would have retained within the main family both the best available land and control over the use of mud from creeks, as well as a larger proportion of the cultivable land than they had given to branch households or tenants. So the pattern of land distribution would have been re-inforced by the distribution of the best quality land.

(iii) horses and other capital assets.

A horse was the most important capital input required by Saga Plain farmers. One horse could cover the ploughing of about one hectare. It was necessary for a household to cultivate at least 1½ hectares to have the capacity to keep and feed a horse (Isobe,76,p.14). So only medium- to large-scale

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(1) Dr. Isobe expressed the same view in converstion with me.

(2) See Smith, 29, pp. 54-59, on the pervasiveness of the distinction between "old" and "new" families in Tokugawa villages, and pp. 41-43 on the practice of retaining major assets within the main family when establishing a branch.

cultivators were able to keep horses of their own and utilise them to capacity. In a village studied by Isobe, it was still true in 1939 that every household owning a horse farmed more than one hectare (and only 5 out of those 26 farmed less than 1½ hectares), while of the 11 households not owning a horse, only one farmed more than a hectare (Isobe,77,table 6).

The scale economies inherent in horse ownership therefore meant that small-scale cultivators had to gain access to the use of horses owned wholly or partly by others. Horse time could be rented, or borrowed from larger-scale cultivators with whom the small farmer had ties. Sometimes those who had insufficient land to provide fodder for a horse all year round would own one but send it away to be looked after elsewhere in the prefecture during the winter. Some horses were owned communally by groups of households. These sorts of arrangement did provide the smaller farmer with access to horses. But he did not have the advantage, gained by the farmer with sufficient land to own his own horse, of having a horse available whenever he wanted it. This was especially important during the autumn, when land had to be ploughed in a limited length of time if a second crop was to be grown. It meant that it was difficult for those who did not own horses to double-crop.

The concentration of horse-ownership amongst the medium- to large-scale cultivator group therefore strengthened the relative economic position of such farmers, both by enabling them to use the technology most efficiently and by giving them control over an asset which they could rent out or lend in return for other services. Ownership of other relatively large-scale pieces of equipment, such as ploughs, strengthened this group still further, as did their possession of the rights to use mud from the creeks. So the ownership of capital assets in general intensified the division of village society which emerged from consideration of the distribution of land.

The structure of the distribution of productive assets which has begun to be pieced together here can be summarised and simplified by considering it as made up of two groups of households: the group, comprising about two-thirds of village households, who cultivated small holdings (owned or rented) of at most a hectare, the majority cultivating less than half a hectare; and the remaining

third of households, mostly cultivating somewhere between one and three hectares, a few owning and/or cultivating more, who owned the best land and the bulk of the capital assets of the village. This division will recur later on when we consider the differences in the way the economies of these two types of household worked. The aim of this section has been to show that the basis of these differences lay in the distribution of productive assets amongst households.

3. Economic Relationships within the Village.

The Japanese village community was, and to some extent still is, a closely-knit body, self-governing in many aspects of its life. To this day a majority of Japanese villages have communal arrangements for such things as road works, repair of irrigation facilities and so on. The communal ownership and management by the village as a whole of irrigation systems and of woodland from which to collect fertiliser formed a basis for this. Where plots were scattered throughout the village land everyone's interest lay in ensuring an even supply of water throughout the system, and the order and timing of the flow of irrigation water to individual fields was managed by the village as a whole. The irrigation facilities and the village woodland were thus run as kinds of public good, so as to ensure a fair supply to all.

On the Saga Plain, however, neither communal woodland nor the irrigation system served as a basis for mutually beneficial ties between the households of the village. There was no mountain land from which to collect fertiliser. Creek irrigation involved no communally-owned ponds or reservoirs for storing water and no village organisation of the flow of irrigation water. Although the village organised the opening and closing of the sluice gates which controlled the entry of water into the village creek network, the supply of water to any individual household's fields depended on that household's efforts at pumping. Indeed, there was even competition between farmers over the supply of water. Enthusiasts would get up very early, moving quietly so as to avoid waking their neighbours, and would begin pumping before everyone else, while the level of water in the creeks was at its highest and so the distance through which it had to be raised at its least (Miyajima,36,pp.14-15).

So Saga Plain villages were not held together by the ownership or management of communal resources. Nevertheless, households were linked by relationships based on mutual need. These arose from the ways in which the labour requirements of the technology were met. As we have seen, almost all households with above-average sized holdings and normal-sized families had insufficient family labour to operate their farms. Hiring of labour was therefore necessary to a larger extent than was typical in Japan. The demand for hired labour was met by members of families with small holdings, many of whom, it will later be argued, would have had difficulty in feeding their families on the output of their farms. The characteristics of the way in which this employment was organised created economic and social ties between the two groups of households which emerged from the discussion of the distribution of assets, that is to say, between the upper-medium sized cultivators, who were labour employers, and the small-scale cultivators, who were labour suppliers. These ties held village society together despite the relative lack of communal functions and property.

Employment of non-family workers was not uncommon in Japan during the Meiji period, and even up to the Second World War. There were two ways in which it was typically organised. Permanent deficiencies in the family labour force relative to the area cultivated were made up by bringing workers into the household as members of it. The worker lived with the household, being fed and housed by it, and rewarded, perhaps, after a number of years, with a plot of land to farm himself (Nakane,19,ch.3, or Smith,29,ch.2). Short-term demand for outside labour would be met by hiring temporary workers, who lived and worked on other holdings, on a daily or seasonal basis. By far the largest part of all hired labour was of this sort.

The employment system on the Saga Plain fell between these two types. The technology in use meant that there was a heavy demand for labour for a relatively long period throughout the spring and summer and into the autumn, even for families farming little more than a hectare. This demand was met by members of families from the small-scale cultivator group. But despite working for about nine months of the year on holdings which were not their own, they did not go to live in their employers' households. They continued to live with their families, who operated their own small

holdings. For their nine month period of work they received an agreed quantity of rice, in just the same way as short-term hired labour did. They fall into a category generally known as nenko (annual employees), who typically made up only a small proportion of the hired agricultural labour force in the country as a whole. On the Saga Plain, the major part of the hired labour force was made up of male nenko who became skilled and experienced workers, especially in the difficult operation of tokojime ploughing in which they often specialised.

The nenko system also fell between the two typical employment methods in other respects. Although the nenko were wage labourers, the relationship between employer and employee resembled in some ways that between the worker who was taken into the household and his master. Each employing household would usually have more-or-less permanent relationships with the families supplying it with labour. Even when this was not the case, it was rare to employ someone from outside the immediate area of the village. By the second half of the nineteenth century, employer/employee relationships were becoming more formal, with contracts being written listing duties and payments, but real wages varied little. As long as the outside economy offered little alternative employment for those whom the family holding could barely support, then there was an abundant supply of nenko and employment was decided, not on the basis of price, but through social contact between households. Thus it was not really a market system.

This point is emphasised by the fact that employment arrangements were only part of a complex of relations between households, some economic, some not. Arrangements for the supply of horses and other pieces of capital equipment were often linked up with employment arrangements. So was the granting of permission to raise mud from creeks and the organisation of the necessary groups to carry it out. These economic arrangements were based on family ties or on old patron/client relationships between households, involving obligations on the part of the main households to protect the small ones, in return for an obligation on the part of the small households to supply labour when necessary. Village society was interwoven with relationships between households whereby each helped the other at difficult times, at weddings, funerals, roof-thatchings and so on, as well as in agricultural operations, and employment relations were part of this.

So for the employer households, the system meant an assured supply of skilled labour, without the need to provide permanent subsistence and accomodation for employees within the household. This would have been a considerable burden, given the relatively large number of workers needed and the relatively small-scale holdings of some employers. The worker, on his side, had some guarantee of employment, of help with the supply of horses and equipment, and of other forms of assistance when required. He had the greater independence of his own holding, but the greater risk involved in not being part of a larger landowner's household.

The political and social structure of village society reflected the pattern of these employment relationships. It was the medium- to large-scale, employer households who provided village leadership, including leadership of agricultural organisations, like co-operatives, when they came to be formed towards the end of the nineteenth century. In the village analysed by Isobe (see Table 6.12), this can be seen in the almost complete monopoly of the major village offices held by the larger-scale, main families (honke). According to the villagers who spoke to Isobe, these families had been the main employer households. They were also, from the point of view of village social structure, the central households in the doozoku family groupings, and most of the other significant cultivating households were branches of their families. The large-scale cultivating household whose economy is considered in the next section (Family N) similarly provided leaders of the local co-operative.

The employment system provided the link which made the technology workable within the structure of land ownership. Employment relationships were part of a wider set of economic and social ties between households which helped to ensure security of subsistence for the village as a whole. Thus we have the complementary relationships between technology, the distribution of assets and the connections between households which were postulated as features of the initial conditions period in the framework. As was argued there, their underlying function seems to have been to provide security and the means of survival for the village group.

It is difficult to use standard economic theories to analyse a system such as this, within which economic decisions are heavily conditioned by the whole structure of village economic

relationships. Professor Ishikawa has attempted to develop a theoretical model to use in the analysis of traditional agricultural systems such as this (Ishikawa,58). He shows that, given limited employment opportunities outside the village and scarce resources of land, capital and technical knowledge leading to low productivity levels, a market employment system would not necessarily ensure all village members of at least a minimum subsistence level of income. Although, from the point of view of the larger employing farmer, wage costs might be lower if there was full-scale competition for employment, the resulting disruption of village life, with the unemployed unable to make a living, would not be in his interests. This is especially so when inter-connected irrigation systems operate and plots are scattered around village land. It is not, therefore, necessary to argue that larger farmers, in guaranteeing employment at least at a minimum subsistence level of income, act altruistically. Rather it is simpler to say that, in an economic environment of very great insecurity and risk, and in which the production activities of households are closely inter-connected, the welfare of individual households depends to some extent on the welfare of the whole village community.

This idea seems to provide an economic explanation of the non-market or semi-market relationships between households in the village in areas such as employment, the use of larger items of capital equipment, etc.. They survived from earlier periods of agricultural development in the area because of their value in providing security in the face of great risk and of the mutual inter-dependence of the welfare of members of the village group. Their breakdown, as market forces and changes in technology removed their basis, is traced in subsequent chapters.

4. The Operation of Farm Household Economies and some Examples.

So far, the division of Saga farmers into a group of larger-scale employer/cultivators and a group of small-scale cultivator/agricultural workers has been described in terms of the distribution of land and other assets and relative positions within the economic and social structure of the village. The next step is to consider what can be deduced from this about differences in the

household economies of the two groups.

There is no evidence to suggest that such differences arose from significant variations in the technology employed on different scales of farm. Larger-scale farmers who owned horses and fields with better drainage stood more chance of being able to grow a second crop, but in other respects more-or-less the same techniques were used on all village land. The basic cause of the division was the difference in the factor proportions available to the two sorts of household, i.e. the difference between households with little land but more than adequate family labour forces, and households with more land than the family could work on its own. Household economies therefore divide into those making up the demand side of the labour market, as a result of the technology and the size of their holdings, and those making up the supply side, as a result of the fact that their holdings were not big enough to employ, and to some extent feed, the family. We can see this in operation if we piece together the information available in the sources so as to describe the general accounting frameworks facing the two sorts of household:

i. the small-scale cultivating household: the income of this type of household would consist almost entirely of rice - the rice it grew on its own holding and the rice it received as wages for those members who worked for other households. It might have grown vegetables and other crops for its own consumption, but was unlikely to be able to grow a second grain crop, e.g. of fodder for a horse. From this income in kind it had to meet its own consumption needs, together with payments for rent, interest, hire of equipment and the cost of any inputs which had to be bought commercially. According to Smith, in Tokugawa times 150kg. of rice was only just enough to feed an adult for a year (Smith,29,p.25). In the late 1880s and 1890s, the earliest years for which the prefectural yearbook gives data, average yields in Saga-gun varied in the region of 250-300 kg./10 ares. For a household renting half a hectare at normal rental rates of about 50% of the rice crop, somewhere between 500 and 750 kg. of rice would remain to meet all other expenses and family consumption needs. This would represent little more than bare subsistence for a family of four, and income from outside would be essential if the household were larger than this (e.g. containing unmarried siblings of the househead, or

grown-up children). Many cultivated less than half a hectare and, for them, survival depended on the relationship with the larger-scale household which provided employment and other forms of assistance. The only other extra employment open to them was in the manufacture of straw goods at home.

ii. the larger-scale employer/cultivator: the income of this sort of household would also consist mainly of the rice it grew, some of which it would probably sell for cash. It would also probably be able to grow a second grain crop, to sell, consume or use as fodder, as well as vegetables and so on. In addition it might receive rent for any land it leased out, and payments for the use of horses and equipment and the right to collect mud from its creeks. Its outlays included wages in kind to its hired workers, taxes, and the cost of any purchased inputs, such as a new horse or plough. As a very rough guide, the available evidence suggests that it was necessary to hire at least one nenko for every hectare cultivated in excess of what the family could manage (on average about 1 hectare) (1). In 1906, the first year for which SKTS gives wage data, the annual rate for a nenko was 90 yen. At the prevailing rice price and yield levels, a hectare of paddy would produce an income from rice of about 325 yen. So wage costs would take, at a minimum, a little under a third of the income from rice cultivation on each extra hectare. This would rise if temporary labour was needed as well. Employer households were probably responsible for feeding a more extended family than the small-scale farmer, and had certain obligations to help their workers and tenants (e.g. to provide them with meals sometimes). In early Meiji times at least, the uses to which they put what remained after these needs had been met would have been mainly traditional ones - purchase of land, improvements to the house, entertaining, dowries, traditional food and clothing, trips to shrines, etc..

These hypothetical accounting frameworks can be illustrated by looking at available records of the operation of individual farm household economies. Yamada and Oota have found records of the economic operations of two families belonging to the medium- to large-scale group (Yamada and Oota,46,p.299-311). In both cases the

(1) For evidence on this point, see pp.129-30.

information refers to periods after the beginning of this century, when the initial conditions were beginning to be disturbed by outside developments. Nevertheless, the basic features of both households' activities still had many traditional aspects.

The information about one family, referred to as Family S, comes from a record book kept during the period 1907-12. Family S farmed 1.89 hectares on the Saga Plain. At the beginning of the period it owned 0.74 hectares of this. By the end it had come to own another 0.65 hectares of it. The rest was rented. Family S was thus essentially a medium-scale, owner/tenant household.

Family N, on the other hand, was a very large-scale landowning household. It owned 17 hectares, of which the family farmed 5.2 hectares and rented out the rest. It therefore represents very much the upper level of resident cultivating landlords. During 1917 it kept a record of the labour days worked on its farm, and it is from this that Yamada and Oota draw their information.

The economies of both households retained many elements of self-sufficiency. Even the members of the wealthy Family N grew cotton and mulberry to make their own clothes, vegetables for their own consumption and so on. Both sets of records were kept at a time when Saga farmers were beginning to market increasing amounts of rice and to buy increasing quantities of commercial fertiliser. Nevertheless, the economic operations of even these relatively large-scale farmers were still subsistence-oriented. Grain cultivation was the main occupation of the male members of the household and of employed workers, as is shown for Family N in Table 3.2, but mixed in with this were all kinds of other operations concerned with the household as well as the farm, and production activity is not clearly separated from the running of the household. This would be even clearer had Family N recorded the labour of its women members in the house and on the farm.

Turning to the technical aspects of the production system, the records only cover Household S. Household S's 1.9 hectare holding consisted of 18 separate plots. It used the rotation described earlier and planted a wide range of seed varieties, some improved, some not. It ploughed in the traditional way. By this time, however, it was using commercial fertilisers in quite large quantities. It obtained yields above the average for Saga County, but with wide variation, presumably resulting from the rice-borer.

Table 3.2

THE DISTRIBUTION OF LABOUR TIME IN HOUSEHOLD N.

(Units = days)

	Acting Househead	His Brother	Nenko 1	Nenko 2	Nenko 3
Grain Cultivation	129.2	125.1	122.55	129.75	166.85
Ancillary to Grain Cultivation	71.25	98.35	86.3	89.1	73.8
Miscellaneous	26.8	10.75	24.55	22.55	12.15
Household Activities	27.0	14.4	21.6	24.55	18.2
Help Given to Neighbours	4.5	4.0	5.0	3.0	9.0
Public Work	-	5.5	1.5	6.25	-
Other	16.25	1.9	7.75	7.0	5.5
Holidays	39.0	74.0	23.0	22.5	22.0
Missed Days	-	-	41.75	29.5	26.5
Total Days Worked	275.0	260.0	269.25	282.0	285.5

The period covered is February to December 1917.

Source: Yamada and Oota, 46, p.303.

Thus the overall technology consisted of the basic features of the traditional system (rotation, irrigation method, tokojime ploughing) overlaid with some of the technical improvements which were spreading through the country during the Meiji period and whose impact on the Saga Plain will be examined in the next section.

Let us now turn to the patterns of labour use employed by these households on their given land holdings. Household S consisted of the househead and his wife, his eldest son with his wife and three babies, and his two daughters. In addition, two nenko were employed. Although the individuals employed varied each year, they always came from within the local area (mura). The head of Household N was an official of the local co-operative (sangyoo kumiai), so the farm was run by the next eldest brother. Another younger brother also worked on the farm and they employed three nenko and some other temporary hired labour. The labour of the temporary workers and of the women members of the household is not recorded. Household N had employed the same three men as nenko for some years and all three came from the local area. Neither household's nenko lived with their employer's families, even in the case of one nenko who had no holding of his own to farm.

Family N's records tell us something about the way these labour forces were used. One nenko did 73% of the horse-ploughing, this being 66% of his work in grain production and 40% of his total working days. He was clearly a specialised ploughman. Family members did most of the pumping. The acting househead did the largest amount, although the women probably also did a good deal. Despite their wealth, the members of Family N worked as hard and as long as their hired workers.

These examples have shown something of the operation of the farm household economies of the larger-scale group of farmers. It is much harder to find evidence to describe the workings of the economies of the smaller farmers in the village, the two-thirds who did not employ labour and the half of those who farmed less than half a hectare. Two examples of the kind of household which relied on employment as nenko labour are, however, provided by the cases, described by Isobe, of two farmers who became cultivators of reclaimed land during the 1930s (Isobe,76,p.32). One was born in 1873 and his family worked 0.7 ha. on the Saga Plain. He worked as a nenko and day labourer until he was 30. The other was born into a

family which cultivated 0.4 ha. (0.2 owned, 0.2 rented) on the Plain. He had four brothers. Clearly, such a small holding could not support them, and all five worked as nenko. The growing mobility of agricultural labourers in search of better employment as communications improved is illustrated by the movement of the first nenko. He moved from his village to become a tenant farmer and then farmed in Korea for a time before settling on the reclaimed land. But both men described here were lucky enough to live to see a time when alternative employment opportunities had greatly increased. During the nineteenth century there was no choice but to remain tied to the village and to nenko employment.

A little more evidence about the household economies of Saga Plain farmers can be gained from the results of the Rice Economy Survey of 1913-15. Five Saga Plain households were selected to represent the area for this survey of the economic conditions of rice cultivation, and some of the information collected from them is shown in Table 3.3. All five belonged to the medium- to large-scale cultivator class. The yields they obtained were a little above the average for Saga-gun in the official statistics. It is interesting that there appears to be no correlation between yield and area cultivated. The very large-scale cultivator obtained the highest yield of the highest quality rice. The usual tendency in heavily-populated countries like Japan is for smaller farms to generate higher yields (and lower labour productivity) than larger farms. The Rice Economy Survey provides a little evidence for the absence of this relationship in Saga Plain farming at this time. This would help to explain the co-existence of the relatively large-scale cultivator, like Family N, farming as large an area as its managerial capacity would permit, the medium-scale owner/tenant cultivator, like Family S, and the very small cultivator/labourer. Following Ohkawa's reasoning, this would tend to occur only where yields did not vary greatly between different scales of farm (Ohkawa,22,pp.277-292).

The labour requirements of the Rice Economy Survey households seem to vary enormously. It is possible that the hiring of temporary labour or the use of unpaid labour from branch households explains the variation. Alternatively, employment of nenko, being part of a wider social and economic relationship between households, might not have been related strictly to labour requirements on a given size of holding. It is also possible that, by the 1913-15

Table 3.3

RESULTS OF THE 1913-15 RICE ECONOMY SURVEY.

(Saga Plain area)

	Households				
	A	B	C	D	E
Paddy Cultivated (ha.)	5.98	2.0	2.0	2.5	2.6
Proportion Tenanted (%)	95.3	30.0	50.0	-	46.2
Workers:					
family	5	6	4	4	4
nenko	4	-	1	1	-
total	9	6	5	5	4
Yield (kg./10 ares)	460	433	433	366	408
Value (Yen/150kg.)	14.00	12.00	13.25	11.76	12.00

Source: Isobe, 76, p.18.

period, Saga Plain employers were beginning to try to economise on hired labour in response to the temporary rise in wages which occurred in 1907 and 1908.

The accounting frameworks described here and the evidence, on such things as labour requirements, given by the examples will be used later in assessing the impact of market economy forces on the different types of household. For the moment, however, this is an appropriate point to bring together the main features of the internal village and household economies of Saga Plain farmers, from the point of view of the framework, before going on to look at their relations with the outside world. In summarising, then, the preceding sections linking technology with the natural environment and with the social and economic conditions of Saga Plain villages and households, the following conclusions can be drawn:

i. Technology and natural environment were linked through the adaptations made to the standard techniques of paddy rice cultivation in Japan in response to the two major problems posed by the conditions of the area: low, flat land and the rice-borer.

ii. The adaptations made (treadle-wheel irrigation, special ploughing, the phased rotation) meant adaptation of the whole technical system to complement them, as in Fig. 3.3, so that it was difficult to make fundamental changes without solving both major environmental problems at once.

iii. The distribution of land and other assets which existed on the Saga Plain after the Meiji Restoration was such that it is possible to regard village society as divided into roughly two groups. The first, containing about a third of households, consisted of those farming above-average sized holdings of a hectare or more, and the second, containing the remaining two thirds, consisted of households farming, on the whole, very small holdings, the majority less than half a hectare.

iv. This land tenure structure was made compatible with the demands of the adapted technology through economic and social arrangements between households which ensured, for larger cultivators, a supply of hired labour to meet the heavy requirements of the technology and, for smaller cultivators, a guarantee of employment and help in bad times. The overall principle guiding these economic

arrangements was the need to ensure the stability and survival of the village group, upon which the welfare of each individual household to some extent depended.

5. The Saga Plain and the Outside World during the Initial Conditions Period.

This section will consider the relationships between Saga Plain villages and the outside world, as represented by outside markets and by government and research authorities, during the initial conditions period. It will deal in detail with the attempts to diffuse Meiji Noohoo techniques and improved methods of pest control. These reveal, firstly, the obstacles to the adoption of standard new techniques posed by the interrelationships between the various aspects of the initial technology and, secondly, the building up of the relationship between farmers and research and extension officials as they tried to overcome the problems involved in diffusing new techniques. The extent of such a relationship is a crucial element in the working of the framework model in Chapter 1, and is a precondition for the existence of an induced innovation mechanism.

(i) the village and outside markets.

As can be seen from the discussion of the household economies of Saga Plain farmers, contact with outside markets was limited, at least before the turn of the century. From the point of view of agricultural inputs and output, village self-sufficiency was high. Most inputs were self-supplied and, with a few exceptions, food requirements were met from the farm's own produce. Some farmers were selling rice, though. Saga rice was known in the main markets of Tokyo and Osaka, and, as we shall see in the next chapter, the quantity and proportion of rice shipped out to these markets was increasing quite fast towards the end of the nineteenth century.

On the labour market side, we have seen that most workers tended not to move out of the village to find employment. However, it became clear, by the time that labour outflow began to speed up after the turn of the century, that some workers did have experience of finding work, at least temporarily, outside their villages, and that this opened up the paths for others to leave when

the outside demand for labour increased. Nevertheless, the majority were confined within the village labour market.

Communications were a vital factor in determining the relatively closed nature of the Saga village economy. Travel by water was possible, but there are no good ports on the Ariake Sea coast of Saga Prefecture. Travel overland was limited by the difficulties of keeping horses. All this was changed, however, by the opening, during the 1890s, of railways connecting Saga City with Nagasaki and with Tosu, hence with Fukuoka and the rest of northern Kyuushuu. These were built in part to facilitate the movement of troops and supplies to the naval port at Nagasaki, but they clearly made the transport of goods and people from Saga into the outside world far easier. The impact of the opening up of the Saga Plain economy to outside influences, which this facilitated, is the subject of the next chapter. Before this, however, during the initial conditions period, the difficulties of communication meant that contact with the outside world was limited.

(ii) the village and the authorities.

We have already seen that governmental involvement in Saga Plain agriculture goes back beyond the Meiji Restoration, with official interest in drainage and irrigation projects, land tenure, and so on. This tradition was carried on after 1868 by the agricultural department of the new prefectural government, which continued to be involved with the study and administration of Saga agriculture.

We saw in Chapter 2 how, during the 1880s, farmers began to form discussion groups, co-operatives and seed exchange societies at the local level. They were eventually brought together in a pyramidal state system by the Agricultural Societies Law of 1899. Through this network the authorities were able to diffuse information about the new Meiji Noohoo techniques down to the village level.

The same kind of network was built up in Saga, with the prefectural agricultural authorities working through the agricultural societies of Saga Prefecture and Saga County to reach Plain farmers. In 1901, the Saga Prefecture Experiment Station was established on a site by the station in Saga City. Its task was to adapt and develop new techniques for the Saga area and, before World War II, it was responsible for diffusion as well as research. In 1904 the prefectural

agricultural department issued "7 Major Points for Agricultural Improvement", which summarised the new technology as it applied to Saga and represented the package the authorities were trying to promote. The 7 points were:

i. more attention to insect control
ii. the cultivation of better seedlings
iii. unification and improvement of seed varieties
iv. improved use of fertiliser
v. selection of seeds by using brine
vi. use of check-row planting
vii. use of deep ploughing

The attempts made by research and extension officials, from the Agriculture Department and later from the Experiment Station, to diffuse this package of standard Meiji Noohoo techniques, with its added emphasis on pest control, are worth considering in some detail because they provided the basis for the relationship between farmers and officials out of which subsequent and more dramatic changes in technology emerged. The sheer difficulty involved in trying to induce Saga farmers to adopt standard Meiji Noohoo techniques and to use known pest control methods forced extension officials into close contact with cultivators and this, it will later be argued, was a crucial precondition for the success of subsequent technical developments. This difficulty arose, firstly, from the incompatibility of some parts of the Meiji Noohoo package with the initial technical system on the Saga Plain, and, secondly, from the impossibiblity, within that system, of adopting any solution to the rice-borer problem other than the use of extremely laborious, unpleasant and not entirely effective methods. To see this, we must look at the main lines of research and extension work on Saga Plain agriculture during the Meiji period.

The rice-borer was the most pressing problem facing farmers in the second half of the nineteenth century and it was, therefore, to this that the representatives in Saga of the new breed of enthusiastic farmers turned their attention. On the basis of their individual experience, they built up a considerable body of knowledge about the rice-borer's life-cycle and habits. In 1878, the prefectural government backed this work up by financing a study trip to Saga by a noted expert on insect pests and, on the basis of his advice and the accrued knowledge of the farmers, the first regulations for insect

control were issued. These included measures to enforce the use of luring-lamps, the burning of stubble after the harvest, the collecting of eggs and damaged stalks from among the growing plants and so on.

Such measures were not effective unless everyone in the village applied them. They also involved a great deal of painstaking work. It was not, therefore, an easy matter to enforce their use over the whole Plain area. Many sets of regulations were issued and it was possible for the police to fine or imprison those who did not obey them. But the most effective method of enforcement was to send officials round to each village instructing and exhorting.

The work of these officials was not easy. Each was assigned a certain area over which he travelled from village to village, lecturing to farmers, showing them how to carry out the control techniques, and checking that they did so. The museum of the Saga Experiment Station possesses photographs of them, incongruously dressed in boaters and stiff collars, lecturing villagers or working with them in the fields collecting rice-borer eggs or damaged stems. They often met with hostility and opposition in their efforts to persuade farmers to undertake these extremely laborious tasks. There are stories of attacks on them, of their being pursued and besieged by angry farmers. Villagers would watch out for them, signal each other when they saw them coming and quickly appear to be doing whatever it was they were supposed to be doing. They were said to use check-row planting while the officials were watching over them, but next year revert to their old ways (1).

Nevertheless, this work did succeed in spreading the new control techniques sufficiently widely to achieve visible results in the stabilisation of yields, although they could not prevent really disastrous years like 1893. More significantly, extension officials were building up contacts with villages and beginning to earn the respect of farmers through the success of the methods they advocated. This served to back up the other research and diffusion work of the authorities - the testing of seed varieties, the experimentation to find optimum fertiliser levels, the circulation of information, advice and regulations to farmers, the holding of ploughing competitions, the awarding of prizes for high yields, and

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(1) See Miyajima,36,pp.35-36, including photographs of the officials at work.

so on. For instance, the winner of the 5 koku per tan (750kg./10. ares) prize in 1913 was greatly assisted in his efforts to achieve this phenomenal yield from one of his plots by a technician from the prefectural authorities. This according to Eguchi, greatly increased the other villagers' respect for their technician (Eguchi,33, Vol.1, pp.142-6).

On the research side, the work of the authorities also produced highly significant results. After the establishment of the research station, scientific experiments were carried out which confirmed what was previously thought to be true about the life-cycle of the rice-borer. The most important result of this research was the discovery that the moth virtually never appeared from its chrysalis after the last two weeks in June. This meant that the insect must breed, develop and hatch from the early crop. This was a crucial discovery because it meant that if one single rice crop were planted over the whole Plain area after the middle of June there would be no rice-borers to attack it. The research authorities had therefore found the solution to the rice-borer problem.

It is at this point that we find our first evidence of the barriers to technical change imposed by the complementary structure of the initial conditions. The head of the prefectural agricultural society decided to launch an experiment to see whether this solution to the rice-borer problem would work. He used for the experiment the village of which he was head and the village of which a close friend was head, and in 1913 these villages planted one single late rice crop.

The experiment was a dismal failure. Since it was only carried out over a limited area, moths hatched in adjoining villages could come to lay eggs in the crop, and no significant reduction in damage was observed. But more fundamentally, the villagers found that they were unable to pump enough water to cover the whole of their paddy area at one time. Thus the only complete solution ran up against the bottleneck of labour supply for pumping and transplanting, with the given irrigation technique.

We find the same barriers at work, though less dramatically, when we come to consider the diffusion of the rest of the 7 points, the basic Meiji Noohoo technology. The clearest conflict came over deep ploughing. This was simply not adopted at all. The important criterion for ploughing on the Plain was not depth but the

formation of a good base, and tokojime ploughing was an essential part of the technical system as long as the raising of irrigation water required so much human labour. As in the case of Family S, Saga Plain farmers were beginning to use increasing quantities of commercial fertiliser. The use of commercial organic fertiliser spread throughout Japan, especially after the Russo-Japanese War (1904-5), and in Saga Prefecture the consumption of soy-bean cake fertiliser rose from 1,653 tonnes in 1905 to 9,183 tonnes in 1909, and that of dried fish fertiliser from 1,428 tonnes to 2,720 tonnes in the same period (Yamada and Oota,46,Table vii 8). By 1917 approximately half of the value of fertiliser consumed in Saga Prefecture came from commercially purchased fertilisers (SKTS,86). But because they continued to use shallow ploughing, Saga farmers did not reap the full benefit from this increased input.

The return to this investment was also below what it could have been had farmers consistently used improved seed varieties. Family S, for instance, used both traditional and improved seed varieties. A survey of rice varieties in Saga County in 1915 found about 80 different varieties in use, of which 4 could be classed as improved (Isobe,76,p.13). At the end of the Meiji period, the most widely used early variety was planted on only 16% of the prefecture's paddy area (Yamada and Oota,46,p.249). The reluctance to use the new varieties stemmed from the fact that their resistance to the rice-borer was felt to be less than that of the traditional local varieties.

Similar objections operated against the use of better cultivation methods. It was thought that the healthy-looking seedlings produced by more careful seed selection, oblong seed-beds and check-row planting simply attracted rice-borers all the more strongly. Without check-row planting it was impossible to use improved weeding tools, and so the vicious circle continued. The research authorities did eventually succeed in inducing farmers to use these improved cultivation methods, but they met with considerable resistance, and their spread was slower than elsewhere. Again the results were not what they could have been had the entire package been adopted.

Another factor which limited the incentive for Saga Plain farmers to adopt Meiji Noohoo techniques was the fact that they could not, like farmers elsewhere, reap the combined benefits of the new technology and investment in improving irrigation facilities. The problems of irrigation and drainage posed by the creek system were

not such as could be solved by known methods of improving land infrastructure. So the majority of land projects carried out in Saga Prefecture in the early 1900s, for instance, were in non-Plain areas (Yamada and Oota,46,chapter 6, section 2), and Plain farmers lacked this additional incentive to adopt the Meiji Noohoo.

So it is clear that research and extension officials faced severe problems in trying to raise output and reduce pest damage on the Saga Plain. The fact that rice yields did begin to show a steady rise after the 1890s is therefore a measure of the amount of work and effort that was expended in overcoming farmers' resistance. Farmers had been persuaded to adopt those parts of the Meiji Noohoo package that were compatible with the basic structure of their technical system, but further change was blocked until new solutions to the fundamental environmental problems could be found. The longer-term results of the 30-40 years' experience of contact with farmers which this represented will become clearer later. By now, we have reached the period after the turn of the century when the initial conditions were beginning to be disrupted by outside forces, and this is the subject of the next chapter.

CHAPTER 4

The Impact of Industrialisation on the Initial Conditions.

This chapter concerns the impact on the villages of the Saga Plain of the rapid industrialisation of the northern Kyuushuu area. The argument is that industrialisation altered the demand for marketed agricultural output and the relative availabilities of production factors to agriculture, and that this led to changes in the socio-economic organisation of agricultural production in the villages. The initial conditions equilibrium between economic organisation and technology was thus disrupted, resulting in pressure for development of new techniques which would be compatible with the new structure. The growth of industry and of the market economy are seen as the primary stimuli for the development of new techniques.

The industrialisation of northern Kyuushuu was part of the upsurge in industrial growth which took place in Japan at around the turn of the century. On the basis of the widespread development of small-scale industry in the latter half of the nineteenth century, the stimulus provided by military demands during the Sino-Japanese War (1894-5) and the Russo-Japanese War (1904-5), along with the expanding trade opportunities opened up for non-belligerent countries during the First World War, launched Japan on the road towards becoming a fully-fledged industrial country. Her remarkable victory over Russia in 1904-5 marked her entry into the warring world of the great western industrial powers and the development of her heavy industrial base proceeded rapidly from then on.

Despite its remoteness from the other industrial, administrative and cultural centres of Japan, northern Kyuushuu was in the forefront of this development. This was the result of two factors, one the extensive coal fields of northern Kyuushuu, and the other the commercial and naval importance of the port of Nagasaki. In 1901 the Yawata ironworks was set up in Fukuoka and this was followed by the establishment of more heavy industry in the Fukuoka/Kita-Kyuushuu area during the first decade of this century. In 1893 the existing dockyard of the Mitsubishi Shipbuilding Company in Nagasaki was enlarged and another yard constructed. In 1895 it was

electrified and improved in other ways, in 1905 a third dockyard was built and in 1907 further enlargements were carried out. After the Russo-Japanese War shipbuilding development spread to other centres, notably Sasebo.

This rapid expansion of heavy industry led to large influxes of labour and rapid urbanisation. Over the whole country the population of the six largest towns more than doubled between 1886 and 1903. The population of Fukuoka was about 50,000 in 1889, and 80,000 by 1908. Table 4.1 shows the increase in the labour force of the Mitsubishi Shipbuilding Company in Nagasaki. The growth of urban industry led, in the familiar manner, both to the withdrawal of labour from agriculture in the neighbouring countryside and to the expansion of demand for marketed agricultural produce to supply the industrial work force.

1. The Demand for Saga Rice.

The impact of industrialisation in northern Kyuushuu on the demand for the output produced by Saga villages revealed itself in two ways: in the quantity and price of rice marketed and shipped out of the prefecture, and in the destinations to which it went. In the early Meiji period, Saga rice was known in the major rice markets in the big cities of Honshuu and it would appear that rice marketing was increasing. In the mid-1890s, however, the quantity of rice shipped out of the prefecture rose sharply (see Chart 4.1, the original data for which are given in Appendix Table 2). According to the Nooji Choosa (Survey of Agriculture) of 1888, 24,150 tonnes were shipped out in that year (Isobe,76,p.23). According to the prefectural data shown in the chart, the level in 1892 was much the same, but by the end of the decade levels of 55,000 tonnes were being reached.

The causes of this rapid increase in rice marketing would not appear to lie in growth of output. There was little rise in yields or output levels during the 1890s, and the effects of the adoption of Meiji Noohoo techniques and better pest control methods were not felt strongly until after the turn of the century. What occurred at this time was a rise in the proportion of output marketed. In the early 1890s, marketed rice represented about 20% of the crop on average, but by the end of the decade this had risen to 40%

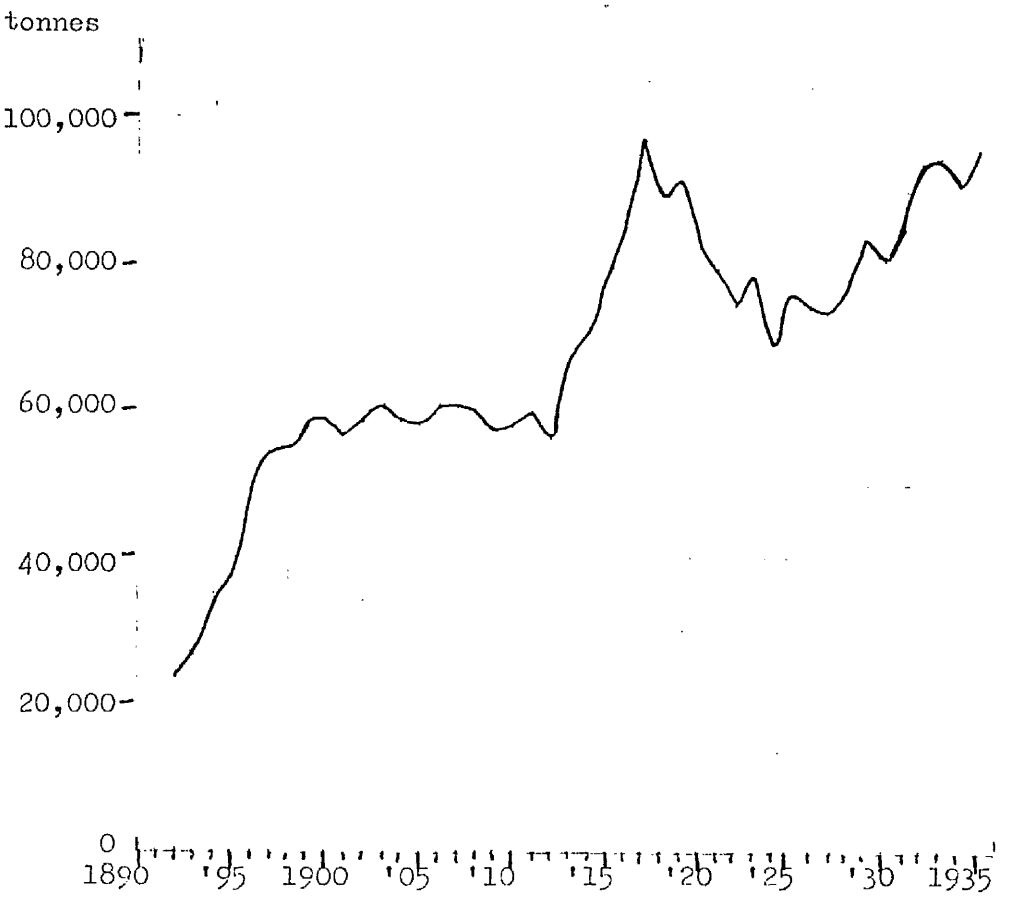
Table 4.1

NUMBERS OF EMPLOYEES OF THE MITSUBISHI SHIPBUILDING CO. IN NAGASAKI, 1889-1936.

1889	1,224
1892	1,532
1897	3,935
1901	5,226
1907	10,191
1912	8,778
1917	15,405
1922	13,571
1931	6,127
1936	13,421

Source: Isobe, 76, p.30.

Chart 4.1: Rice Shipped out of Saga Prefecture, 1892-1935.
(5 Yearly Averages)



Source: Saga-ken Tookeisho (86).

(calculated from SKTS,86). The most obvious explanation of this would be the improvements in communications brought about by the opening of the railway connections to Saga City in the 1890s. This meant not only easier access to distant rice markets but also greater possibilities for buying inputs and consumer goods previously made at home. So the incentive for acquiring cash income may have risen along with the ease of marketing rice.

Rice marketing remained at a roughly constant level during the 1900s, but as industrialisation and urbanisation in northern Kyuushuu speeded up, it began to affect the demand for locally-produced rice. Its impact can be seen in the chart in the rapid increase in rice marketing during the 1910s, from levels of around 55-60,000 tonnes during the 1900s to a peak of 95,000 tonnes around 1917. Growth in output in this and the previous decade contributed to this rise, but the proportion of the crop marketed (for the prefecture as a whole), which had declined somewhat to levels of about 35% during the 1900s, rose to over 50% in the boom years of the late 1910s.

The influence of the demand side is confirmed by the switch in the main markets to which Saga rice was sent. In the closing decades of the nineteenth century, most of Saga's rice had been shipped to the main industrial areas of Japan which at that time were outside Kyuushuu, chiefly to the Osaka/Kobe area and to Tokyo. By 1914 these areas were taking only 40% of the rice sent out of Saga, and by 1921 the Osaka area took only 12.7% and Tokyo 6%. Only 24.8% went outside Kyuushuu at all, while Nagasaki took 44.8% and Fukuoka 30.2% (see Table 4.2). Thus it came about that Saga became almost exclusively a supplier of rice to the north Kyuushuu industrial areas. Factories in Nagasaki and Fukuoka made special contracts with Saga farmers to supply the rice for their workers and Saga's position as a major supplier is clear from the table. Almost 80% of the rice coming into Nagasaki Prefecture was from Saga.

The reflection of these trends can be seen in the available data on the price of rice in the Saga market, shown in Table 4.3 and plotted in index form in Chart 4.3. Prices remained relatively stable during the 1900s, but rose rapidly in the 1910s as the increase in demand came to be felt.

How was Saga able to fulfil this role as specialist rice supplier to the north Kyuushuu urban areas? As we have seen,

Table 4.2

THE MARKET FOR SAGA RICE.

Destination	Total Imported from Other Prefectures (tonnes)	Quantity coming from Saga (tonnes)	Percentage coming from Saga	Percentage of Total sent out of Saga
	A v e r a g e 1 9 1 9 - 2 1			
Fukuoka Prefecture	77,850	22,050	28.3	30.2
Nagasaki Prefecture	40,950	32,700	79.8	44.8
Kyuushuu Total	150,150	54,900	36.6	75.2
Kyoto, Kobe, Osaka	361,200	9,300	2.6	12.7
Tokyo, Yokohama	806,550	4,350	0.5	6.0
Non-Kyuushuu Total	1,686,300	18,150	1.1	24.8
Total	1,836,450	73,050	4.0	100.0
	A v e r a g e 1 9 3 4 - 3 8			
Fukuoka Prefecture	138,000	38,100	27.6	38.9
Nagasaki Prefecture	51,750	41,250	79.7	42.1
Kyuushuu Total	214,350	79,500	37.2	81.2
Kyoto, Kobe Osaka	438,900	10,050	2.3	10.3
Tokyo, Yokohama	981,300	6,750	0.7	6.9
Non-Kyuushuu Total	1,986,000	18,450	0.9	18.8
Total	2,200,350	97,950	4.1	100.0

Source: Isobe, 76, p.24, taken from two national surveys of the trade in rice, carried out by government departments.

Table 4.3

THE PRICE OF RICE IN SAGA CITY, 1899-1937

(Yen per Koku = 150 kg.)

1899	9.2	1919	42.7
1900	11.0	1920	41.8
1901	12.3	1921	27.0
1902	11.8	1922	31.2
1903	13.2	1923	28.4
1904	13.1	1924	34.9
1905	12.0	1925	37.0
1906	14.3	1926	34.4
1907	14.3	1927	30.2
1908	14.3	1928	26.2
1909	12.2	1929	26.2
1910	13.0	1930	16.1
1911	17.5	1931	16.0
1912	19.5	1932	20.5
1913	19.8	1933	20.5
1914	14.4	1934	20.8
1915	11.9	1935	28.7
1916	*	1936	30.1
1917	17.8	1937	31.6
1918	30.7		

* not available.

Source: SKTS, 86.

environmental conditions were, within limits, favourable to rice production on the Saga Plain, and, within these limits, output was increasing after the turn of the century. But leaving aside for the moment Saga's technical ability to meet the demand, there are three factors, arising from the structure of the market in which she operated, that made Saga's position a particularly favourable one:

i. The rice which Saga Plain farmers were able to produce in large quantities was not of particularly high quality. The risk posed by the rice-borer inhibited the use of high-quality, as well as improved, seed varieties. But beyond this, the technical and economic structure of Saga agriculture was designed to produce large quantities only of low-quality rice. Higher-quality rice would have required more careful cultivation and better preparation for market, all of which would have demanded more labour than was available at the right times under the technology. However, the consumers who made up the demand side of the North Kyuushuu market were industrial workers and their families, who could not afford high-quality rice. The cheap rice of Saga was therefore ideal for them.

ii. Rice from southern Kyuushuu was of a higher quality than Saga rice. Therefore, not only was it at a disadvantge from the point of view of communications and transport costs, but it was also, of itself, more expensive. This reduced the competition from domestic sources that Saga had to face.

iii. Perhaps the most interesting of these three points arises from the fact that Saga rice sold at about the same price as imported Korean and Taiwanese rice, and, as a result, little foreign rice entered the North Kyuushuu market (Isobe,76,p.27). Hayami and Ruttan ascribe a major role in causing the stagnation in Japanese agriculture during the inter-war period to the depressing effect on prices of the large-scale import of colonial rice (Hayami and Ruttan, 55). Saga farmers, with their product so perfectly adapted to its market demand, did not feel this effect so strongly, though, of course, by the same token they failed to gain some of the benefits which farmers elsewhere obtained from more intensive, higher-quality production. In as far as a high and stable level of demand was a factor influencing subsequent technical and structural change, then the fact that Saga farmers did not suffer severely the effects of increased colonial supplies in their market must be of relevance. Comparison of the development of Saga agriculture with that of the rest of Japan in this

light adds weight to Hayami and Ruttan's thesis, but too much should not be made of it because Saga was very different from the rest of Japan in many other respects as well. While it might be possible to argue that, had the price of Saga rice fallen more as a result of competition from imports in the '20s and '30s, the incentive to invest in new techniques would have been greatly reduced, this involves assuming away the whole structure of environmental and technical conditions which determined that Saga rice would be of low quality.

From the point of view of the village economy, the industrialisation of northern Kyuushuu provided Saga Plain farmers with a large and easily accessible market for their rice. This affected both the quantity and the nature of the product they marketed and brought the Saga village economy firmly into the sphere of the commercial economy. In the second half of the nineteenth century, as we have seen, the village economy was largely self-sufficient. Even the bigger landowners, who were selling rice in the market, were still producing subsistence crops to supply themselves with food and clothing. The extent to which this had changed by 1917 is clear from Table 4.4, which shows some of the results of a detailed survey on "Levels of Rice Production and Consumption" carried out in Saga Prefecture in 1917. By this time cultivators in Saga City and County were selling 74% of the rice which they retained after paying rent, on the assumption that all rental rice was sold commercially. This represented 58% of all the rice marketed from Saga City and County. Commercialisation had advanced much further in the Plain area than in the rest of the prefecture. For the prefecture as a whole, farmers were selling only 51% of their rice crop. The hill areas of Saga had neither the geographical conditions nor the transport facilities which enabled the Plain farmers to develop into specialised commercial rice producers (1).

Increasing contact with the towns and with commercial markets brought with it not only greater opportunities to sell products but also greater opportunities to buy them. Household goods previously made at home came to be bought in the market and the farmer's cash requirements increased along with the increase in his cash income.

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(1) The divergent development paths of the hill and plain areas of Saga Prefecture is a subject of considerable interest, inadequately dealt with here. The comparison is made simply for the purpose of pointing out the extent of commercialisation on the Plain.

Table 4.4

PROPORTION OF PRODUCED RICE SOLD, 1917.

(Tonnes)

	Saga City & County	Saga Prefecture	
A. Output	37,500	166,950	
B. Rent	13,200	55,050	
C. Retained by Farmers	24,300	111,900	(A-B)
D. Consumed by Farm Households	6,300	54,300	
E. Sold by Farmers	18,000	57,600	(C-D approx.)
F. Sold by Landlords	13,200	55,050	(B approx.)
G. Total Sold	31,200	112,650	(E+F)
% of Retained Output Sold By Farmers	74	51	(E/C)
% of Total Output Sold	83	68	(G/A)
% of Marketed Output Sold by Cultivators	58	51	(E/G)

Source: Isobe, 76, p.28.

The nature of the market which Saga came, almost exclusively, to supply also influenced the type of product she sold. The consumers in the north Kyuushuu industrial area did not demand high quality rice and Saga farmers did not try to produce it. The authorities tried hard to do as other prefectural authorities were doing and raise the quality of marketed rice. They were anxious that the price of Saga rice, almost the only product that Saga had to sell to the rest of Japan, should not fall relative to that of rice from other areas. But Saga farmers could not be induced to grow uniform good varieties. Neither would they pack their rice in the way used elsewhere or use the standard size of bag adopted almost everywhere else after 1913. Saga was also one of the prefectures with the lowest levels of storage capacity (Isobe,76,p.24-6). Such efforts to improve rice marketing failed in Saga because the market conditions which farmers faced put them under no pressure to produce good quality rice and there was insufficient competition to force them to change their marketing practices.

To summarise, then, the analysis of the effect of industrialisation on the product market side, the expansion of industry and urbanisation in northern Kyuushuu provided a huge opportunity to sell rice for consumption by the new industrial workers. The Saga Plain was in an ideal position to meet this opportunity both because it was environmentally suited to rice cultivation on a large scale and because of its easy communications by rail and boat with the major markets. This gave it considerable advantages in competition with other rice-producing areas, as did the quality of rice which it was technically suited to produce. So it was that Saga Plain farmers switched their existing marketed rice from the industrial areas of mainland Honshuu to those of northern Kyuushuu, expanded their rice marketing and became specialised producers of rice for a rapidly expanding market.

2. The Demand for Labour.

Saga villages were major suppliers of labour to the factories of Fukuoka and Nagasaki. Although farmers in Saga were not as poor as those in some other parts of Kyuushuu (e.g. Kagoshima, Miyazaki), these poorer areas were more remote and did not possess the excellent means of communication which linked Saga with the major

industrial areas. Labour did not really begin to flow out of these other areas until the mid-1920s. In the early stages it was from villages in neighbouring prefectures that most of the new industrial workers came. Table 4.5 shows that Saga was the main source of labour for the chief industrial cities, apart from the prefectures in which they were located. In 1924, 7.4% of the workers at the Yawata iron-works in Fukuoka came from Saga, putting Saga fourth among prefectures supplying labour to it (after Fukuoka itself, Oita and Kumamoto), and 6.4% of workers at the Mitsubishi shipyards came from Saga, so that Saga was here the second largest labour-supplying prefecture after Nagasaki itself (Isobe,76,p.27).

How did this outflow of workers affect the village labour force and economy? It has been pointed out that the village labour market during the second half of the nineteenth century was by and large a closed one. But it was also true that those who were able to find any seasonal work outside the village did so. Thus there were workers who were used to travelling to the towns to find work. When employment opportunities began to expand rapidly during the 1910s these contacts smoothed the way for many workers to leave their villages to find industrial employment. At first individual workers began to leave and the number of farm workers on the Saga Plain began to decline from about the 1890s. The progress of this decline is plotted in Chart 4.2, from which it can be seen that the number of farm households began to fall rapidly from about 1912, as workers became established in the cities and took their families with them. By 1921 the number of farm households had declined to 80% of its 1892 level. The number of workers had reached 80% of the 1892 level by 1907 and by 1921 had reached 50% of it. The total population of Saga Prefecture rose from 510,000 in 1883 to 700,000 in 1915, but after that the rate of outflow began to exceed the rate of natural increase and the population ceased to increase. Between 1920 and 1940 Saga had the second highest population outflow rate in Japan (Kyuushuu Noosei Kyoku, 35, p.22).

This labour outflow meant that the number of farm households in Saga reached a peak and began to decline earlier than was typical in Japan. This is particularly interesting in the light of Professor Sawada's finding that a significant correlation exists between the date at which the number of farm households in a prefecture began to decline and the level of rice yields in that prefecture in 1903-7. The earlier the number of households began to

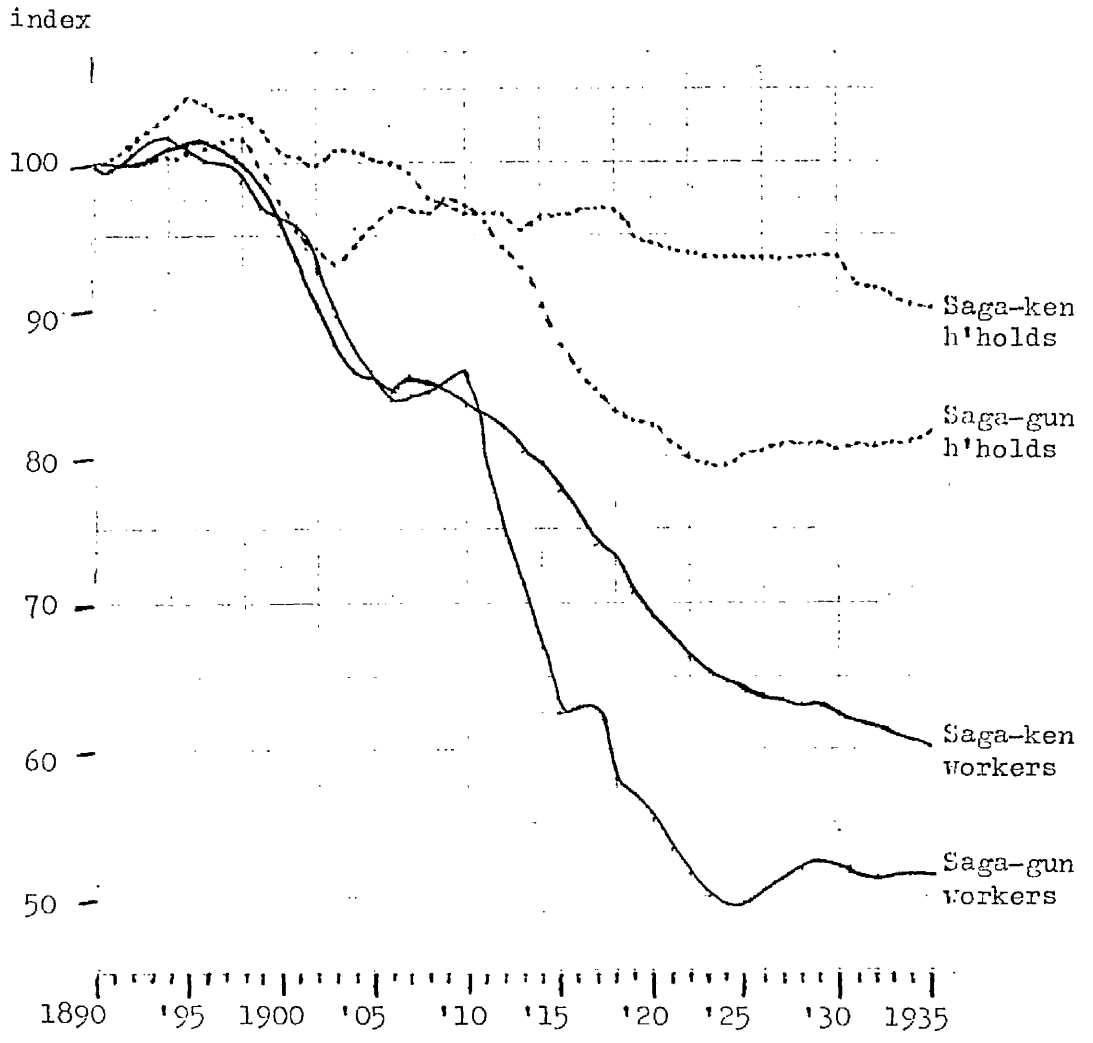
Table 4.5

POPULATIONS OF FUKUOKA AND NAGASAKI PREFECTURES BY PLACE OF ORIGIN, 1930.

	Total Population	Of which born Outside Prefecture A.	Of which born in Saga B.	B/A x 100	Position of Saga among Labour-supplying Prefectures
Fukuoka Prefecture	2,527,119	539,052	71,554	13.2	3
Fukuoka City	228,289	60,785	13,226	21.8	1
Nagasaki Prefecture	1,233,362	174,500	57,775	33.1	1
Nagasaki City	204,626	42,150	9,932	23.6	1
Sasebo City	133,174	66,760	27,223	40.8	1

Source: Isobe,76,p.31, from census data.

Chart 4.2: Agricultural Workers and Households, 1890-1935.
(Indices of 5 Yearly Averages, 1890=100)



Source: Calculated from data in Saga-ken Tookeisho (86), shown in Appendix Table 3.

decline the higher the rice yield to be expected in 1903-7. Sawada used data for 41 prefectures and in only 6 of them did the number of households begin to decline earlier than it did in Saga (1). Although the most significant rises in yields in Saga occurred after 1903-7, the existence of the relationship is revealing and much of the subsequent description and analysis of this and later chapters will be concerned with showing how, in this particular case, the relationship between a declining agricultural labour force and a rise in rice yields worked.

We have seen that the village structure on the Saga Plain contained a class of small-scale farmers unable to make a living without working for outside employers. It was clearly from this class that most of those who left agriculture in this period came. The result was a decline in the labour force available for hire within the village. The structural impact of this will be examined in detail in the next section, but the immediate effects can be seen in the rapid rise in wages for hired agricultural labour, especially towards the end of the 1910s, which is shown in Table 4.6 and plotted as an index in Chart 4.3.

What was most relevant to the structure of the village economy was the relationship between the two effects of industrialisation described here, that is between changes in wages and changes in the price of rice. This is shown in Chart 4.3. Also shown is an index of wholesale prices, to give a rough idea of the real effect of the changes. Until about 1905, wages and prices rose slowly in parallel, leaving real wages roughly constant. In 1907 wages rose sharply above the rice price, showing the first disturbing impact of the outside labour market in Saga. But then they dropped back again for a while. After 1915 both wages and prices began to rise fast. The rice price hit a peak in 1919, but after this began to decline almost continuously until 1931. Wages continued to rise until 1922, and it is significant that the period 1919-22 was a crucial one in the development of new techniques. After this, wages declined a little, but to nowhere near the same extent as prices. Nominal wages, especially those of the annual employees, held up much better than

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(1) Data kindly given to me by Professor Sawada and used by him for the correlations reported in Sawada,69.

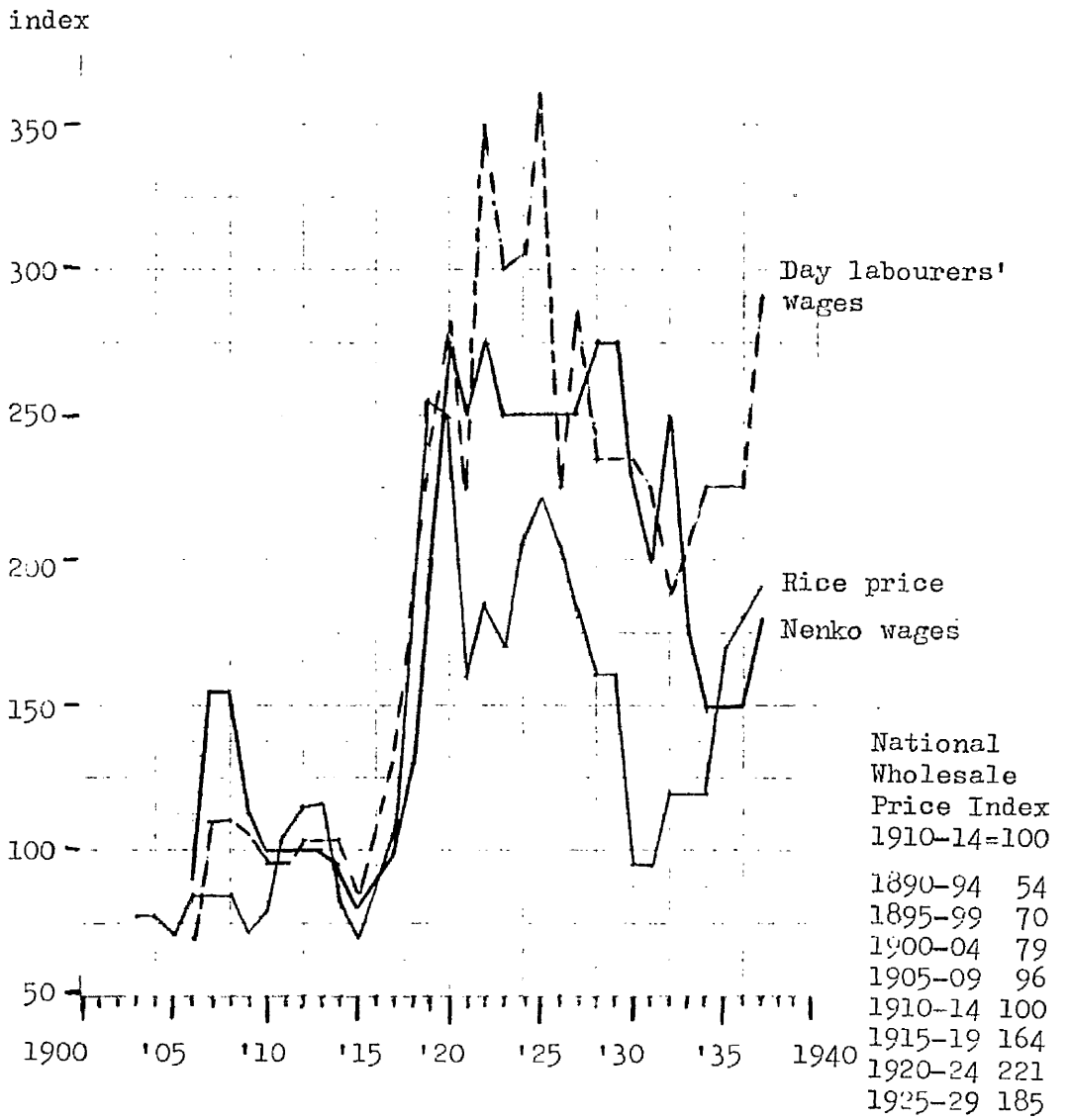
Table 4.6

WAGES OF MALE AGRICULTURAL LABOURERS IN SAGA (Yen).

	Nenko Per Year	Day Workers Per Day
1906	91	.37
1907	156	.58
1908	156	.58
1909	113	.55
1910	100	.50
1911	100	.50
1912	100	.55
1913	100	.55
1914	95	.55
1915	80	.45
1916	*	*
1917	100	.70
1918	130	.70
1919	200	1.27
1920	275	1.50
1921	250	1.20
1922	275	1.85
1923	250	1.60
1924	252	1.65
1925	*	1.90
1926	*	1.20
1927	250	1.50
1928	275	1.25
1929	275	1.25
1930	230	1.25
1931	200	1.20
1932	250	1.00
1933	175	1.10
1934	150	1.20
1935	150	1.20
1936	150	1.20
1937	180	1.55

Source: SKTS, 86. * not available.

Chart 4.3: Indices of Wages and the Price of Rice in Saga Prefecture. (1910-14=100)



National Wholesale Price Index 1910-14=100

1890-94	54
1895-99	70
1900-04	79
1905-09	96
1910-14	100
1915-19	164
1920-24	221
1925-29	185
1930-34	135
1935-58	171

Sources: Rice price and wages indices calculated from data in Saga-ken Tookeisho (86), wholesale price index calculated by the Bank of Japan and quoted in Lockwood (16), p. 300.

the more flexible rice price during the depression years. Both began to rise again after 1931-2 but the divergence was not wiped out. In 1935 nenko's wages fell to their lowest point since before their big increase and after that the level of daily labourer's wages rose faster than that of the nenko reflecting structural changes in labour demand. But the real wage for agricultural labour was substantially higher after the First World War than it had been before it,as a result of the impact of industrialisation on the village, rising higher than, and remaining above, the level of the wholesale price index, as well as the local rice price.

3. The Impact of Industrialisation on Household Economies.

The previous section has shown how the industrialisation of northern Kyuushuu in the first two decades of this century affected the villages of the Saga Plain, via a reduction in labour supply and rise in wages, and via an increase in demand and high prices for agricultural products. This section begins by describing the changes in the economic and social situations of different kinds of household within the village economy, and the observed responses to them, as industrialisation proceded. It then examines what lay behind this- the quantitative impact of the changes in relative prices- by using the hypothetical accounting frameworks for different types of household, discussed in the previous chapter.

i. the small-scale cultivator/agricultural labourer.

Those at the bottom of the size distribution of cultivators, who owned or rented only a small area of land (less than about half a hectare) and who relied on employment as agricultural labourers for their livlihood, were faced with a new choice as a result of the expansion of employment opportunities. One of the basic assumptions behind the communal village employment system, that there was no alternative employment outside the village, no longer held. The choice was, by and large, a simple one, between remaining a farmer, possibly with higher wages, and leaving the land altogether to become an urban industrial worker. The distance between Saga and the major cities was enough to make commuting to work from the family farm difficult. The scope for industrial part-time employment within agriculture also did not develop much on the

Plain (1). Therefore, this group of farmers was faced with a straight choice between agriculture and industry, and it is clear from what we have seen that, despite the rise in agricultural wages, farming could not match the stable employment and higher wages offered by industry. The productivity of labour, under the existing technology, was not enough to be able to provide an income comparable with an industrial one. Although at first people left singly, once it became clear that industrial employment was easily available and stable in supply, whole families began to leave, as we have seen, giving up their holdings in agriculture altogether. Thus it was that the agricultural work force in the Saga Plain area dropped by about a half between the 1890s and the 1920s.

For those small farmers who remained behind conditions also improved. Their wages were rising and, because there was now alternative employment, they were less dependent on their employers and landlords. Relations between employer and employee became more strained and Kamagata argues that the social position of the smaller farmer and his social relationships with bigger farmers were much changed (Kamagata,34,p.183). Employer/employee relationships became much more commonly governed by written contracts. In any case, the traditional employment system was broken down by this impact of the commercial economy on the village, and it is clear that employer/employee relations were ceasing to be governed by the community employment principle. They were now determined by market laws of supply and demand. The employee class had chosen the market system and abandoned the community employment principle, now that one of its fundamental assumptions no longer held and it had ceased to offer them the better alternative.

ii. employer farmers. The choice was not so clear-cut for those owned larger amounts of land and other assets tied to agriculture. The greater a farmer's income from the ownership of land and capital, as well as from his labour, the less was industrial income able to compete with it. Furthermore, with the price of rice rising fast, the more such farmers had to sell, the greater their incomes could be. The problem was the supply

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(1) In the hill areas of Saga Prefecture, however, increase in the availability of side-employment was the major way in which industrialisation affected agriculture.

of labour - both its price and its availability.

As we have seen, almost all farmers cultivating more than a hectare or a hectare and a half needed to hire labour. Given the technology in use, their demand for labour was for virtually permanent, skilled, male labour. The long period of heavy work required by the rotation meant that workers must be locally resident and available for the major part of the year. Therefore, with the available labour force falling so fast, it became very difficult to find workers of this sort, and the technology made it impossible to tap other sources of labour in Saga or further afield. The structure of the labour market was such that wage rises may not have reflected adequately the disequilibrium between supply and demand for this kind of labour. The relationship between the nenko and his employer was not strictly a market one, and if the nenko felt that the ties between them were strong enough to prevent him leaving, then the wage he received may not have been a competitive market one. So, especially for the farmer who had to hire a good deal of labour, the problem was not only one of rising wages but also one of the availability of the kind of labour required by the technology.

Two kinds of response to this situation were observed amongst those who remained in agriculture. Firstly, every effort was made to save on hired labour and to substitute family labour for it. This was especially so amongst middle-sized farmers who did not need to hire a great deal of labour in the first place. Women had to work the wheels and children returning from school were sent straight out to pump (Kyuushuu Noosei Kyoku,35,p.236-7). Farmers resorted to the expedient of removing soil from the fields to lower their level. This meant that water did not have to be pumped so far, so that fewer wheels were necessary. But it also meant that the field was harder to drain and therefore to use for a second crop. This was not such a severe drawback, however, since not planting a second crop was another means of saving on hired labour. It meant less need to have labour available in the autumn for harvesting the rice crop and planting the second crop in the available time. So temporary workers for the spring and summer could be substituted for the permanent nenko. The result of this can be seen in the fact that the area planted to second grain crops in Saga Prefecture declined from 30,000 ha. (out of a total cultivated area of 50,000 ha.) to 23,000 ha. between 1916 and 1919, and had fallen to

below 20,000 hectares by 1923 (Kamagata,34,Table 16,p.239).

The second type of response, made particularly by those at the top end of the size distribution, was simply to reduce the area cultivated. The effect of this on the overall size distribution will be examined in the next section, but it is clear that larger-scale landowner/cultivators were either selling their land, or splitting it up and giving it to branch families, or renting it out to tenants. This would yield them a return in the form of rent and/or labour services. The decline in the number of really big landowners especially was accentuated by the collapse of the post-World War I boom, as a result of which they lost many of the assets they had invested in banks and other enterprises outside agriculture. But basically the problem was that, without the community employment system, which had depended on the non-existence of alternative employment opportunities, the larger cultivator could not go on farming from year to year with security.

The link, at the level of the individual farm, between these observed responses and the changes in relative factor prices and availabilities can be filled out by making use of the information on farm household economies presented in the last chapter. Table 4.7 is an attempt to show, through hypothetical accounts, the impact of the changing structure of relative prices on farms of different sizes, between 1913-15 and 1922. The period 1913-15 has been chosen because, as can be seen in Chart 4.3, it represents a relatively stable period, from the point of view of price changes, before the dramatic rises set in, and because the data available in the Rice Economy Survey (see Table 3.3) cover this period. 1922 was a year of relatively low rice yields, but it was a crucial year, as we shall see, as regards the decisions of farmers to invest in new techniques.

The columns contain estimates of the effects of actual price changes on incomes and expenses for different sizes of farm, within a highly simplified and hypothetical accounting framework. The half-hectare farm represents the mass of very small cultivating households, some of whose members would have been working out as nenko. The one hectare farm represents the average-sized cultivation unit, depending, for the most part, on family labour alone. The two hectare farm is a relatively large-scale cultivating unit like Family S. The five hectare farm is a very large unit, of which there

Table 4.7

CALCULATIONS OF HYPOTHETICAL CHANGES IN EXPENSES AND INCOMES OF SAGA PLAIN FARMERS BETWEEN 1913-15 AND 1922

		1913-15				
Area Cultivated	ha	½	1	2	2	5
Rice Yield	kg/10ares	373	373	373	373	373
So, Rice Output	kg	1865	3730	7460	7460	18,650
Price of Rice	¥/100kg	10	10	10	10	10
So, Value of Rice Output	¥	186.5	373.0	746.0	746.0	1,865.0
Total Labour Requirements	persons/ year	2	4	5	6	8
Family		4	4	4	4	4
Hired		-2	0	1	2	4
Wage Rate	¥/year	92	92	92	92	92
So, Hired Labour Cost	¥	+184	0	-92	-184	-368
Fertiliser Cost	¥	46.6	93.2	186.5	186.5	466.2
Total Net Income	¥	323.9	279.8	467.5	375.5	1030.0

		1922				
Area Cultivated	ha	½	1	2	2	5
Rice Yield	kg/10ares	355	355	355	355	355
So, Rice Output	kg	1775	3550	7100	7100	17,750
Price of Rice	¥/100kg	20	20	20	20	20
So, Value of Rice Output	¥	355	710	1420	1420	3550
Total Labour Requirements	persons/ year	2	4	5	6	8
Family		4	4	4	4	4
Hired		-2	0	1	2	4
Wage Rate	¥/year	275	275	275	275	275
So, Hired Labour Cost	¥	+550	0	-275	-550	-1100
Fertiliser Cost	¥	88.7	177.5	355.0	355.0	887.5
Total Net Income	¥	816.3	532.2	790.0	515.0	1562.5

were few, but it represents perhaps the upper limit of cultivated acreage, and we have Family N as a model for it.

The yield data show average yields for Saga-gun, taken from SKTS. The farmers in the Rice Economy Survey obtained somewhat higher yields than those shown, but for the sake of comparison the county average is used. As stated earlier, there is no evidence to suggest that yields varied with area cultivated, so the same figure has been used for all farm sizes. The rice price is the average for the year in Saga City, as are the wage rates, and both come from SKTS.

The estimates of labour requirements are based on the scattered information presented in the previous chapter. It is assumed that two adult workers would be enough for a half hectare farm, since we know that one was sufficient to do almost all the pumping, and the family members who worked outside would probably have been able to help on their own farm. The same kind of reasoning, as regards pumping, lies behind the assumption that a labour force of four was necessary for a one hectare holding. A hectare seems to have been about the limit to what a family labour force could manage. The estimate for the two hectare farm is the most difficult. The Rice Economy Survey households vary enormously in the size of their labour forces. But taking into account that Family S employed two nenko, in addition to family labour, on a farm of a little less than two hectares, six seems a reasonable estimate. However, the calculation is repeated for a labour force of five, in order to show the effect on a two hectare household's income of reducing its hired labour force. Household N, farming five hectares, employed three nenko in addition to the family labour force, but also a considerable amount of temporary labour. The six hectare farm in the Rice Economy Survey had a labour force of nine. Eight therefore seems a reasonable figure to assume for a five hectare farm. The assumption of a family labour force of four (say, a couple plus older children or dependent relatives, male or female) for all sizes of farm may be unrealistic. The larger-scale farms would almost certainly have had larger numbers of dependent relatives. But judging from the village studied by Isobe in 1939, these would probably have had more effect on reducing income per family member than on removing the need for hired labour.

Fertiliser expenses are the only other input it is possible to estimate, and this is done very approximately by taking 25% of the value of rice output. This is the value given in the Rice

Economy Survey. We have some figures for the value of fertiliser input and rice output in Saga-gun in the 1920s (in SKTS), and the relationship between them varies from around 19% to 29%, so there seems to be no reason to assume that the proportion had changed by 1922.

The calculation is forced to ignore the cost of other inputs, such as the use of horses, and it assumes all farmers own their land so that rent does not enter the picture. Output from non-rice crops is also ignored. It could be argued that their inclusion would tend to accentuate the change in the relative position of the larger-scale farmer. He was more likely to have been double-cropping initially, since he probably owned horses and better-drained land, and was therefore more likely to have had to reduce his double-cropping as labour became more scarce and expensive.

The calculations show both the declining relative position of the larger-scale farmers, and the pressure on the upper middle-sized farm to reduce its labour force. Comparing the two periods, with a doubling of the rice price, an increase in the wholesale price index used earlier from 100 in 1910-14 to 164 in 1915-19 and 221 in 1920-24, and a slight decline in yields, the dramatic rise in wages has meant that the income of the small-scale household, with two members working outside as nenko, has increased by 150%. That of the one hectare farm has risen by 90%. The income of the 2 hectare farm employing 2 nenko, on the other hand, increased by only 37%, and even if it only employed one nenko, the increase is still less than that of the one hectare farm at 68%. The increase for the 5 hectare farm is 52%.

The very small farm with labour to hire out has benefitted enormously from the rise in wages. By 1922 its total household income is greater than that of all except the 5 hectare household. This must involve some exaggeration because of the neglect of rent, second crops, etc.. But assuming that urban wage rates were higher than those of nenko, it is clear that the incentive to give up farming and enter full-time paid employment was very great for such households.

Turning to the very large-scale farmer, he has seen his wage costs rise from just under 20% of the value of his rice crop to over 30%, and the difference between his income and that of the one hectare farmer or the two hectare farmer with one nenko become smaller. Most significantly, if he were to rent out one hectare of his land, creating a one hectare sized farm, at a rent equal to half the value

of the rice crop (which is approximately what rents were), he would in 1913-15 have received an amount equal to 68% of the per hectare income on land he cultivated himself. By 1922 this had risen to 85%. So the incentive to let out land, reducing the cost and trouble of managing a labour force which was becoming increasingly difficult to hold, was great. If he was prepared to sell land, he would find that the price of a hectare of middle-grade paddy land had risen from about 2,800 yen in 1913-15 to 7,140 yen in 1922 (see Table 4.10), so that his return, in terms of his income from rice production per annum as a proportion of the value of his land, had fallen from 7.3% to 4.4%. Added to this is the fact that, taking Saga-gun as representative, the labour force on the Plain had declined by about a quarter over the period, so that recruitment of nenko must have been hard even given the rise in wages. The situations of the one and two hectare farms show the increasing pressure to save labour in the medium scales. With the substantial rise in his family income and the rising price of rice, the one hectare farmer had every incentive to try to increase the area he cultivated to the absolute limits of the family's labour force. Meanwhile, the two hectare farmer employing two nenko was, by 1922, actually making a lower total income from rice cultivation than the man with only one hectare. Reducing the hired labour force as far as possible was therefore imperative, making a very large difference to family income. It was worth doing even if it meant reducing the area cultivated, since more could be earned on one hectare without employing nenko than on two, if two nenko were necessary. These forces would explain the strain on the family labour force, as farmers in the middle ranges tried to save on hired labour, the pressure from both sides pushing farmers into the 1-2 hectare range, and the desire to press for new labour-saving techniques.

4. Changes in the Size Distribution of Holdings.

How did this differential impact of industrialisation on the economies of the various types of household within the village affect the distribution of cultivated land? Table 4.8, based on the prefectural data shown in Appendix Table 4, summarises the observed trends in the size distribution of cultivated land. It clearly shows an increase in the numbers of households cultivating ½-1 hectare and

Table 4.8

CHANGES IN THE DISTRIBUTION OF HOUSEHOLDS BY AREA CULTIVATED IN SAGA PREFECTURE

(units = households)

Cultivated area (ha)	1908	change 1908-18	change 1918-28	change 1928-38	1938	change 1908-38
Under 0.5	25,480	-4274	-2837	-1843	16,526	-3954
0.5-1	24,892	+ 452	- 405	-4074	20,875	-4017
1-2	12,927	+3992	+1858	+2564	21,341	+8414
2-3	5,889	-1362	- 149	+ 688	5,066	- 823
3-5	1,587	- 503	- 335	+ 188	934	- 653
Above 5	323	- 224	- 62	- 11	26	- 297
Total	71,098	-1909	-1933	-2458	64,768	-6330

Source: Kamagata, 34, p.185, from basic data as in Appendix Table 4.

1-2 hectares in the 1908-18 period, matched by declines in both the total number of households and the numbers cultivating less than half a hectare and more than two hectares. The changes in the cumulative distribution are plotted in Chart 4.4, and the comparison between this and Chart 2.2 shows that the trend towards concentration in the middle ranges of the size-scale was more marked in Saga than in the country as a whole. For the Plain area itself, Yamada and Oota (Yamada and Oota,46,p.299) give the following figures for the distribution of households by area cultivated in Saga-gun between 1920 and 1924:

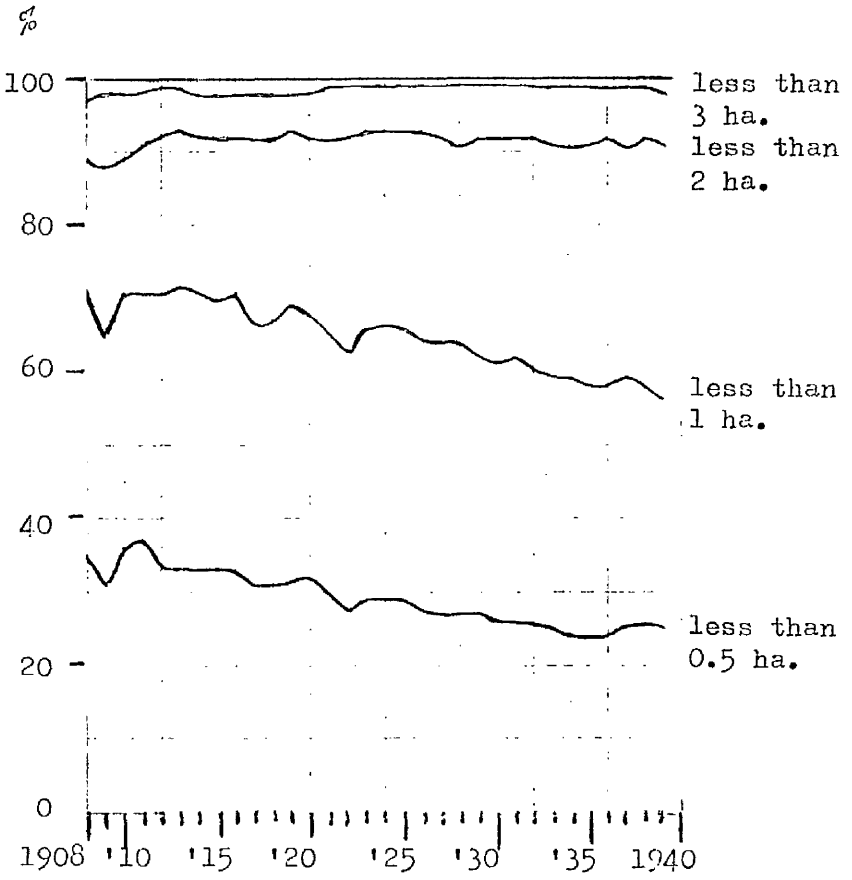
Area cultivated in hectares	under .5	.5-1	1-2	2-3	3-5	over 5	total
Percentage of Households	20.9	25.8	35.4	14.1	2.7	0.1	100

If we compare this with the picture of the distribution of holdings in the second half of the nineteenth century, as described in Chapter 3, we can see the shift towards the middle ranges of the size-scale.

This trend was accompanied by an increase in the proportion of households falling into the owner/tenant category. Table 4.9 shows that, for the Plain area, the period up to 1910 witnessed an increase in the number of households who were either pure tenants or pure owners of the land they cultivated, but this trend was sharply reversed after 1910, with the proportion of owner/tenants rising from 37 to 52% in the 1910-20 period. The same trend is visible, though less distinctly, in the data for the prefecture as a whole, shown in Appendix Table 2. So the increase in the numbers farming middle-sized holdings was matched by an increase in the proportion of households who both owned and rented in land.

It is easy to see that these trends are the result of the differential impact of industrialisation and its effect on the dynamics of the size structure of holdings. The decline in the proportion of very small cultivators must be due simply to out-migration. But the increasing concentration in the medium-scale, owner/tenant group can be seen as the result of the forces described in the last section. Let us take,to begin with, the case of a small farmer cultivating less than half a hectare who does not leave agriculture and finds that his income from employment is rising as is his income from cultivation (as the price of rice rises). He

Chart 4.4: Cumulative Percentage Size Distribution of Cultivated Holdings, Saga Prefecture, 1908-39.



Source: Calculated from data in Kayoo (83), as shown in Appendix Table 4.

Table 4.9

MOVEMENTS IN NUMBERS OF AGRICULTURAL WORKERS BY TENURE STATUS IN SAGA COUNTY AND SAGA CITY.

(units = people)

	Owners	%	Owner/ Tenants	%	Tenants	%	Total (100%)
1900	19,260	36.3	26,593	50.0	7,241	13.7	53,094
1905	17,101	38.0	18,664	41.5	9,194	20.5	44,959
1910	17,763	39.0	16,870	37.0	10,956	24.0	45,589
1914	9,709	30.7	15,031	47.4	6,970	21.9	31,710
1920	7,788	27.5	14,902	52.6	5,629	19.9	28,319
1925	7,883	29.8	13,276	50.2	5,261	20.0	26,420
1930	8,064	28.7	14,915	53.0	5,167	18.3	28,146
1936	7,403	26.2	15,684	55.4	5,231	18.4	28,318

Source: Isobe, 76, p.30, calculated from SKTS.

begins to accumulate a little capital with which he is able to buy his own or a similar holding if he does not already own it. Because he is making profits he considers expanding the area he cultivates and finds that there is land available, both because others are leaving agriculture and because big landowners are anxious to reduce the area they cultivate. So he increases the size of his holding by renting in land and becomes an owner/tenant. Eventually, if he is competent and no disaster strikes him, he will, as long as the rice price stays high, expand to the point at which he cannot farm any more land without hiring extra labour to supplement that of his family. This would be at around the one hectare level. Hiring labour would prove difficult and would raise his costs greatly, so his expansion would tend to come to a halt within the 1-2 hectare range. At this point he would probably be an owner/tenant.

Consider now a larger farmer cultivating three, four or five hectares. As labour becomes increasingly scarce and expensive, he finds it harder and harder to cultivate his land efficiently, and increased wage costs eat up the extra revenue he receives for his rice. He notices also that smaller farmers are not suffering so badly from the labour shortage and are doing well from the high rice price. He could sell up his whole holding and go to the city, but he has no guarantee that he could, with the capital he thus acquired, earn an income equivalent to what he could earn as a cultivating farmer. His more likely course, under the incentives suggested by the hypothetical accounts, is to try to rent out some of his land to some smaller-scale farmer, or sell off some of it, or establish some relative or dependent as a branch family, farming part of the original holding independently but, hopefully, helping out the main household with labour. He will reduce his holding until he reaches the point where he can farm using only the labour of his family with perhaps help from his branch households and a little temporary hired labour. This would tend to put him too at around the 1-2 hectare level.

We can see this process happening in the increasing level of land sales through the 1910s. Banks in the Plain area reported a rush to borrow money to buy land (Isobe,76,p.32). Villagers would come together to form "mutual financing associations" (tanomoshi-ko) to secure loans to buy land. Many farmers, who borrowed money to buy land in the good years before the collapse of

the post-World War I boom, were thrown into difficulties by the decline in the rice price, but still this continued purchase by smaller-scale cultivators and landowners formed the basis of the expansion of the middle-sized owner/tenant class, and is reflected in the rising price of land shown in Table 4.10.

5. Disequilibrium in Structure and Technology.

It is now possible to bring together the structural changes brought about by industrialisation and the technical system described in the previous chapter. It can then be seen that the balance within and between the economic and technical structures was disrupted (as it had not been by the technical change and output growth of the Meiji period) so as to raise pressures for change.

We saw in the last chapter how the traditional technology of the area, based on creek irrigation with treadle-wheels, the two parallel rotations and the necessity for meticulous horse ploughing, was overlaid, but not fundamentally altered, by the new techniques which were spreading through Japan during the Meiji period. In particular, the input of commercial fertiliser was increasing, and, to complement this, new seed varieites were beginning to be used, and improved cultivation techniques adopted.

In this chapter we have seen how the industrialisation of northern Kyuushuu rapidly opened up the village economy to the influence of the outside world. Farmers were drawn into the commercial economy by the expanding demand for their ouput as well as by their increased purchase of commercial inputs and consumption goods. They became producers of a specialised product for a particular market. In addition, labour had been drawn away from the village, wages had risen and the small-scale cultivator/agricultural labourer had become a better paid, more independent worker or was moving up to become a medium-scale farmer.

As a result of these changes, the middle-scale farmer became the one who could operate most efficiently with the given technology. Small-scale cultivators had new, non-agricultural opportunities opening up to them, and large-scale cultivators were being driven, by the outflow of labour and collapse of the traditional employment system, to reduce the area they cultivated. But, in order

Table 4.10

THE PRICE OF LAND IN SAGA PREFECTURE.

(yen/10 ares of middle-grade paddy)

1913	293
1914	286
1915	271
1916	177
1917	347
1918	416
1919	671
1920	677
1921	658
1922	714
1923	614
1924	640
1925	625
1926	613
1927	635
1928	668
1929	645
1930	621
1931	509
1932	511
1933	498
1934	498
1935	519
1936	544
1937	646
1938	710

Source: Isobe, 76, p.33, taken from a survey of land sales made by the Hypothec Bank of Japan.

for the middle-scale farmer to reap the benefits of the new situation, he had to stretch the factor substitutability of the technology to its limits if he was to operate it under the changed conditions of factor availability. Land and family labour power were being substituted for hired labour as far as possible within the structure of the old technology. But the scope for doing this without reducing output was not great enough to avoid severe strain on the family labour force. Yield-increasing practices, like careful weeding and insect control, not to mention double-cropping, had to be abandoned if pumping labour demands were to be met. Pumping labour could be reduced by lowering the level of the field but this lowered yields and made double-cropping difficult. The old technology could not be operated effectively within the new structure.

Thus we have seen how the impact of industrialisation via its differing effect on the economies of the households within the traditional village structure brought about changes in that structure. We have seen how industrialisation opened up the internal village labour market to the influence of the commercial economy, thereby breaking up the traditional community economy. We have seen how the expansion of the demand for marketed agricultural output, which industrialisation brought about, provided a necessary condition for these changes. But we leave the economies of Saga Plain villages in a somewhat unstable state. The traditional technology remains in its essentials unchanged, with its fundamental problems unsolved. But it is now being utilised under conditions of quite different relative factor supplies from those under which it developed, and without the traditional village organisation which made it operable in the past. The ways in which this disequilibrium was overcome are the subject of the following two chapters.

CHAPTER 5

The Development and Introduction of Mechanised Irrigation Pumps

In terms of the framework of Chapter 1, we have now reached the point at which the outside economy has come to influence the initial conditions (Arrow 1). The effect has been to disrupt the equilibrium of social and economic arrangements existing within the initial conditions. The change in relative prices and factor availabilities has brought about shifts in the distribution of cultivated land and has broken up the traditional economic and social relationships between households. This has resulted in the emergence of the middle-scale owner/tenant household as the predominant type of farm unit, but has left such farmers operating a technology designed for a different set of factor prices and structure of relationships between households.

This chapter concerns the development and introduction of a technical change which came to transform the whole technology and to generate the increases in yields and in labour productivity which made Saga famous. The questions it seeks to answer are how and why was this particular technique developed. It was designed to deal with the problems of one particular part of an overall technology, and the first stage in answering these questions is to consider how this specific problem point emerged from the interaction between the change in factor availabilities and the technology of the initial conditions. The specific problem to which a technical solution is sought cannot be predicted solely from knowledge of changes in factor availabilities and prices, without understanding how these changes relate to the initial technology. Neither can the characteristics of the solution developed be predicted without bringing in the forces within the initial conditions which influence their choice. The first section will therefore consider what determined the specific problem to which a solution was sought, and describe the factors within the initial conditions influencing the choice of the characteristics of the solution. Subsequent sections will describe the way in which the choice was made and the resulting new technique diffused. They will show how the middle-scale owner/tenants played the role of the initial innovator group, as described in Chapter 1.

1. The Emergence of the Problem.

The first point to make is that, by the late 1910s, the existing technology was placing definite limits on farmers' ability to respond to the changed situation of demand and relative prices. With expanding demand and rising prices farmers had every incentive to try to produce and market more rice. This could have been done either by expanding holding sizes and cultivated area per worker, or raising the output of a given holding by applying more inputs to it. But the existing technology, based on the need to deal with the problems of the rice-borer and the labour demands of the irrigation system, made the scope for any such factor substitution limited. Where the family labour force was already fully utilised at the times of peak labour demand, holding size could only be expanded by increasing the labour force and this was extremely difficult now that the number of small-scale cultivators/agricultural labourers had declined so sharply. The more intensive cultivation methods available were difficult to apply to the extent that they required increased labour input, since the family labour force was fully occupied throughout the spring and summer with ploughing and pumping. Fertiliser input could be expanded and, to complement this, improved seed varieties could be planted. But the profitability of such investments in more expensive inputs was reduced by the risk of damage by the rice-borer, and limited by the failure to adopt wholeheartedly complementary labour-using techniques. As the labour shortage worsened it became necessary to adopt measures, such as lowering the levels of fields and abandoning double-cropping, which reduced output and made it even harder to respond to demand pressures.

If we combine this situation with what we know of the existing technology, we can see how the focus of the problem was the technique for pumping water. In the first place, the effect of all the measures taken to try to deal with the labour shortage was to reduce the amount of water which needed to be pumped and/or the distance through which it had to be raised, or to utilise what family labour time was available to substitute for other sources of labour for pumping. From this it is clear that the labour shortage hit Saga farmers most sharply through the labour requirements for pumping, which absorbed such large amounts of time in a simple manual operation when the demand for skilled and meticulous labour for other operations was at its peak. But secondly, the water-wheel technology was also

the bottleneck preventing farmers from producing more to meet the rising demand. In part this was because it inhibited the adoption of some parts of the available package of new techniques, both where they were incompatible with existing water conservation and pest control methods, and where the required labour was not available. In part, also, it was because it prevented the adoption of the only known method of removing the risk of pest damage. Thus the problems caused by labour shortage, combined with the incentive of increased demand, focussed on the labour requirements for pumping. If these could be substantially reduced, then the skilled labour of the family and the remaining hired labour could be concentrated in the areas where it could contribute most to the maintenance and expansion of output. The change in factor availabilities had thus created a specific problem within the existing technical and institutional environment.

The difficulties caused by this problem became more pressing as the decade of the 1910s progressed, as the labour outflow continued and wages went on rising. But as long as the price of rice kept increasing in line, the situation was not desperate. Then in 1919 the rice price hit its peak and began a decline which lasted throughout the depressed years of the '20s until after the Great Depression in 1930-31 and which was not matched by the decline in wages (see Chart 4.3). This made the discovery of a solution to the farmers' problems a matter of urgency.

For the reasons described above, such a solution implied a change in the technique of pumping which would reduce the labour required. This in turn implied the substitution of some form of capital equipment for labour, some mechanised means of raising water onto the fields. Since capital was the production factor which was becoming more abundant in the industrialising Japanese economy at this time, this involved the substitution of a factor which was growing relatively cheaper for one which was growing relatively more expensive, in line with the theory of induced innovation. But the crucial question for those concerned with the choice of technique was, as we shall see, the form in which the capital was to be embodied, the characteristics of the machinery to be introduced. We will consider here four aspects of the general background conditioning the choice, and in the next section look at how it was actually made.

First of all, the general economic development of

Japanese agriculture up to this point placed limits on the choice of technique, by making it unlikely that any large-scale machinery could be developed. Attempts to develop large-scale, Western-type farming methods in Japan had been abandoned early in the process of modernisation, so that the technical knowledge necessary to construct suitable machinery had not been developed. The substitution of land for labour, increasing the area which one man could cultivate, was feasible, but only to a certain extent. Even in Saga, where land reclamation was still taking place and where families were leaving agriculture at quite a rapid rate, the cultivated area did not expand at any great rate relative to the number of farm units. Aside from economic considerations of relative factor supplies, the physical nature of the Japanese countryside and of the irrigation system made the use of large-scale mechanised techniques problematic.

Secondly, the limitations on the scale of machinery were re-inforced by the changes in the economic organisation of Saga village life brought about by industrialisation. The middle-scale farmer had become predominant, so any technique to be diffused widely would have to be such as could be acquired and utilised by a household with relatively limited financial resources and only a family labour force. The significance of this will be clearer later, when it is shown that leadership of village organisations had now passed to the middle-scale owner/tenant group, and that these organisations played an important role in the development and introduction of the new techniques.

The third factor also relates to the capacity of Saga farmers to adopt new techniques, especially mechanised ones. By the 1920s, most of the male members of the agricultural labour force would have received a number of years of primary education and would have been literate (1). This obviously made the diffusion of new techniques easier, for instance by making it possible to use written materials in publicising improved methods. But few Saga farmers were likely to have received education beyond the primary level, and their technical training was limited to what they could learn from extension officials. Furthermore, they had little opportunity for gaining experience in the use of machinery in general, given the highly labour-intensive methods used in agriculture, and in almost

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(1) School attendance became compulsory in 1886.

everything else, in rural areas of Japan at this time. In 1920, there were only 1,785 petrol engines and 683 electric motors in the whole Japanese agricultural sector (Ogura,21,p.414). Embree's study of a village in Kumamoto (one of the prefectures bordering on Saga) in the 1920s showed that the only machines with which villagers had any contact were bicycles, and sometimes pedal-driven threshers and other foot-powered machines for preparing grain (Embree,5,pp.34-37). So the ability of Saga farmers to operate and repair machinery must have been limited as yet.

The fourth conditioning factor was the role which the government and research authorities had created for themselves in the economic and technical development of Saga agriculture. This, it will be shown, provided the link between the economic situation of farmers, represented by village organisations, and the choice of technique. The research and extension officials had, over the course of many years, built up both their knowledge of and their contact with the economic life of Saga villages. They had been instrumental in the introduction of earlier new techniques and their success in this had given them a certain standing with cultivators and a responsibility for them. The story of their role in the development of the mechanised pump will show that the improvement of Saga agriculture was a duty, for which many were prepared to labour in the face of opposition and setback. From this arises the fact that it was the actions of the research authorities which largely determined the characteristics of the new techniques developed and diffused, but that, in these actions, they were aware of farmers' needs. Thus they made the bridge between the economic situation of Saga agriculture and the actual choice of technique made.

2. The Research Authorities and the Development of the Mechanised Pump (1)

It is clear that the research authorities had become convinced of the argument that the introduction of some form of

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(1) The descriptions of the development and introduction of mechanical irrigation and of the new rotation, included in this section, are derived mainly from Miyajima,36,pp.35-55, and Yamada and Oota,46, pp. 329-346.

mechanised pump was essential to the development of Saga agriculture by the late 1910s. For them, it was vital both in order to do away with treadle-wheel pumping, and all the labour and misery that that involved, and to make it possible to irrigate all the land at the same time, hence to plant one crop in late June. There would then be no early crop on which the rice-borer larvae, hatched from the eggs laid the previous year, could live, and hence no moths hatching out to lay eggs in the late crop. The introduction of a mechanical irrigation method of itself would bring immediate benefit to the farmers of the Plain. It would relieve them of the terrible labour of pumping and free them to adopt improved cultivation methods which demanded labour time. But in the minds of the officials who had seen the failure of the late-planting experiment, it was indissolubly linked to the possibility of introducing that change.

By 1918 the Agricultural Land Department of the prefectural authorities had begun to plan the development and introduction of some form of motor-driven pump on the Saga Plain. In the description which follows of the process by which this was achieved, two characteristics are of major importance. The first is the close working relationship between the research workers and the manufacturers of the pumps and motors. The second is the constant interchange between the authorities and the farmers themselves. In both respects we see the fruit of the authorities' work in gathering knowledge about the conditions of the area and in building contacts with the farmers. It was this which enabled them to guide the research and development work of the manufacturing company and continually to test research results by the farmers' experience and capabilities. It was this which made it possible to produce machinery exactly suited to the farmers' needs.

Since the First World War, Japan's industrial capability had improved considerably. Japanese machine-building firms now had sufficient expertise to develop and produce the sorts of motors and pumps required. Without this, the possibility of mechanical irrigation could not have been conceived or realised. But by now engineering capacity had reached a sufficiently high level and Saga was not the only place in Japan where such pumps were being developed and introduced. In neighbouring Fukuoka Prefecture a mechanical irrigation project was already in operation. Under this scheme a 30-50 h.p. engine was being used to irrigate an area of reclaimed land.

The authorities took farmers from Saga to look at this project and to comment on it, a first step in the process of consultation and propaganda whereby a suitable pump was developed and farmers were persuaded to acquire it.

Against this background of improving industrial capability, the research authorities approached the Masaki Iron Company, which had its factory in Saga City, and commisioned it to develop and manufacture a suitable motor and pump. Apart from the experience of other areas, the company also drew on the lessons learnt from an attempt to establish mechanical irrigation in Saga. In 1920 one village tried to use a large, static diesel engine to pump irrigation water. The scheme required the destruction of some of the cultivable land in order to create all the channels necessary to connect it to the fields, and it did not prove a great success because the engine did not work well. The farmers were not able to manage it and they eventually abandoned the attempt.

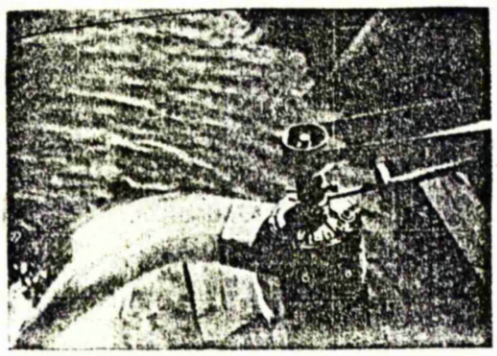
With this experience in mind, the company decided that, rather than develop such a relatively large-scale machine, they would initially produce small, moveable pumps driven by petrol motors, such as were used to pump water on ships. They manufactured 100 of these and they were distributed to farmers who tried them out. They proved to be difficult to move about and troublesome for the farmers to manage and maintain.

At this point, officials from the Prefectural Agricultural Society and the Agricultural Department came up with a suggestion for small-scale electric motors driving static pumps. These could be run continuously and cheaply and could make use of the existing water channels without the need to create new ones on the scale required by larger equipment. Further experiments were carried out and proved successful. In 1921 the final model, a 2-3 h.p. electric motor with a centrifugal pump, was put on exhibition in Saga (see Fig. 5.1). It was relatively simple to operate and had the added advantage that the motor was not heavy and could be removed when not needed for pumping and used to operate other machinery.

However, as the authorities realised, there were problems with this type of pump. Firstly, in order to make it worthwhile to build electricity supply facilities, the pumps would have to be installed over a wide area all at once. This was essential also if their introduction was to be linked to the enforcement of uniform late

Fig. 5.1

THE DESIGN OF THE PUMP



佐賀県牛津町
株式会社　西村鉄工所

川越市松江町
飯野製作所

佐賀市鍛冶町
溝田鉄工所

Part of an advertisement appearing in a magazine in 1953, showing pumps of basically the same design as those introduced in 1922. They were manufactured in Saga.

planting. Secondly, each pump set could supply enough water for several average-sized holdings. With farmers' holdings, furthermore, scattered throughout the village, it was essential that they share the use of pumps if they were to be diffused at all widely. These pumps will be considered in greater detail from the village side later. From the authorities' side, it is enough at present to point out that these characteristics combined to make some sort of communal village organisation of the installation and operation of the pumps essential. But it was not unnatural, given their knowledge of and relationship with the village society, that they should assume that such a thing could be organised.

Furthermore, the organisations necessary for carrying out such a scheme already existed in the form of the irrigation associations (suiri kumiai) which existed in each village to manage the irrigation facilities (timing of the opening of sluices, etc.) and to which all cultivating members of the village belonged. The irrigation associations of all the villages in the central Plain area were linked together in an overall organisation called the Oide Irrigation Association. In 1921, the head of this organisation proposed a scheme to convert the Oide area to mechanical irrigation. Electric motors and pumps were to be installed over the entire 4,500 hectares covered by the Oide Association, under its general supervision and guidance. Under the scheme, the Oide Association would plan the siting of the pumps, the supply of electricity and so on over the whole area. Individual village associations would be responsible for the purchase of the pumps and their installation at the local level. Each village would buy the number of pumps necessary and organise their use on a communal basis. All cultivators would be required to take part in the scheme and it was aimed to convert the entire cultivated area covered by the Oide Association to mechanically-powered irrigation. The vastness of the scheme overwhelmed the delegates to the meeting of the Oide Association when it was presented to them and they did not fully understand or accept it at this stage.

The research authorities, however, did not give up and, with the completion of the machine in 1921, they began a large-scale campaign to advertise the merits of the new pumps. Officials and "conscientious farmers" tramped the countryside lecturing and demonstrating. Parties of farmers were brought to see the exhibited machines and all kinds of propaganda were disseminated. The authorities

negotiated with the local electricity company which agreed to construct the electricity supply network necessary for the Oide scheme. By 1922 the member farmers of the Oide Association were persuaded and agreed to the scheme.

Construction work began, laying the electricity supply lines, installing the pumps and where necessary altering the water channels. 465 pumps were installed and 185 km. of electricity supply cables laid. Other areas soon followed suit under the impact of the authorities' campaign. The Oide scheme finally covered about 5,000 ha. and a survey carried out in 1928 found a further 3,000 ha. of the Plain area irrigated by electrically-driven pumps (Miyajima,36,p.46). In other areas, petrol-driven motors and pumps were adopted. The number of petrol motors in Saga Prefecture rose from 107 in 1923 to 533 in 1927, and continued to rise rapidly after that (1). The treadle-wheel disappeared and the landscape of the Saga Plain became characterised instead by the little wooden huts built to house the motors and pumps.

The diffusion process will be looked at in greater detail from the point of view of the farmers and their economy later. But before we leave the research authorities we must also tell the story of their role in implementing their scheme for the planting of one late crop, which was closely connected, for them, with the introduction of mechanised irrigation.

During 1922 while the installation of the pumps was progressing, important officials of the research authorities began to revive their cherished scheme to beat the rice-borer. The main proponents were the head of the planting section of the experiment station and the chief technicians of the Prefectural Agricultural Department and the Prefectural Agricultural Society. Around the end of 1922, these men began to lobby farmers at the conscientious farmers' discussion societies and to develop a following amongst them. This culminated in the holding in Saga City of a large conference of representatives of every area of the Plain (choo and mura). About 1,000 people were present and they heard the officials explain the results of their 20 years of research on the rice-borer and the effects of planting one late crop on yields, seed varieties, planting methods, labour use and so on. They painted a picture of the benefits farmers

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(1) See Table 6.3 and p.171, where the later development of this trend is discussed.

could gather from abandoning their old customs. According to Miyajima, there was much discussion among the delegates and some disagreement, but in the end the assembly agreed to adopt the achievement of one late crop as a concrete aim for 1923. After heated discussion about what date to select, it was agreed that regulations should be passed prohibiting the planting of rice over the Saga Plain area before June 20th..

As a means to this a number of resolutions was passed. It was agreed that conferences should be held in each county (gun) in January, attended by official technicians, heads of administrative village areas (mura), mura agricultural associations and village (buraku) agricultural associations. In February there was to be a conference in every administrative village area to arrange methods of implementing the scheme. Finally there were to be general meetings of village agricultural associations to make the detailed arrangements. Thus the purpose of the prefectural authorities was to be spread down through every layer of the rural administration.

Opposition to the scheme was, however, stronger among the people of the villages than it had been amongst the more advanced conscientious farmers. Some more remote areas had never suffered so badly from the rice-borer and wanted to keep their traditional ways. Some areas grew types of second crop that would be hard hit by the timing of the new rotation. In places officials were threatened and attacked. But if the scheme was to work, there could not be exceptions to it. The officials pushed patiently on with their task and seemed in the end to have persuaded the majority of the farmers as to the benefits of the scheme.

However, it seems to be agreed that its implementation was not achieved without the use of a certain amount of force. In February 1923 the prefecture issued the necessary regulations. In order to enforce them, five new agricultural offices were set up, each covering a particular area and manned by full-time resident technicians. A hint of the pressure applied on the farmers can be gathered from the fact that, among the 58 people who made up the prefectural insect control department, 11 were prefectural officials, 20 were county (gun) officials and 22 were police officers (Miyajima, 36,p.53). Technicians, meeting at a conference in April, generally expected some areas not to comply with the regulations and they devised procedures for reporting and punishing offenders. They also

agreed on measures to enforce the strictest insect control procedures on areas which did plant early, to prevent any spread of the insect. More and more regulations were issued, increasing the complexity and detail of the scheme, and making it possible to punish offenders with fines or improsonment.

Nevertheless, despite the pessimism of these technicians, the mixture of the genuine conviction of many farmers that late planting would solve the rice-borer problem with the simple obedience to pressure from above of many others, and the effect of the threat of force on the rest, resulted in the scheme's almost total success. In 1923 only 4% of the 20,000 ha. to which the regulations applied was planted with early crops, and a total of 18 people were punished for disobeying the regulations (Miyajima,36,p.54). The harvest that year was somewhat hit by heavy rain in July, but the rice-borer hardly appeared at all. The number of insects caught by the experiment station's luring lamps dropped dramatically. Furthermore, without exception, the areas where early crops were planted were badly hit by the rice-borer. No pressure from above was needed to make them plant only a late crop in 1924.

Thus the traditional parallel rotations, which had been carried out on the Plain for generations, were abolished almost at a stroke and the authorities had achieved a dramatic success which considerably enhanced their reputation with the farmers. But, by contrast with the movement towards the adoption of mechanical irrigation, it is clear that the achievement of late planting was carried out much more by administrative pressure from above. Although it met the needs the farmers had expressed to the authorities and most of them accepted it, yet its implementation involved far less of the interchange and consultation which had characterised the development of the motorised pump. Nor, when we return to considering the village level, will we find, corresponding to the late planting movement, the kinds of local initiative and organisation which went with the introduction of the mechanical pumps. It was a measure which relied for its success rather more on the efficiency of the administrative machine and the acceptance of and the obedience to the will of authority on the part of the farmers, and rather less on co-operation between the farmers and authorities.

Nevertheless the shift to the planting of a single rice crop after the 20th. of June was a change of profound importance to

both the technical and economic structure of Saga agriculture. As we shall see in the next chapter, it provided a great stimulus towards further technical change and, together with mechanical irrigation, broke the vicious circle of stagnation which the old technology had created.

3. The Diffusion of Mechanised Pumping in the Villages.

This section will consider the implementation of the mechanical irrigation scheme from the point of view of the village and its member farmers. Two themes need to be brought out. The first concerns the role of village community organisation in the widespread diffusion of the motors and pumps. The second concerns the part played in this organisational process by the middle-scale owner/tenant farmer group. Through this we can see how the development and diffusion of this innovation was related to the structural changes in the agricultural economy which were described earlier.

To understand the incentives to adopt the new techniques we need to consider the returns they offered to the individual farmer. These accrued in three ways: (1) in the reduction in the cost of pumping involved in the substitution of machines for the hired labour made necessary by the old pumping technique; (2) in the freeing of family labour time from pumping, enabling it to be used for more intensive cultivation of existing land or for farming a larger area, and (3) in removing the physical burden of pumping.

Estimates of the reduction in the cost of raising water suggest that it was very large. According to Yamada and Oota, the initial capital costs of the installation of the pumps and motors under the Oide scheme worked out on average at 15.77 yen per 10 ares. The construction of water channels cost a further 4.86 yen/10 ares (Yamada and Oota,46,p.337). So the investment cost per hectare would just about have been covered by one nenko's annual wage. Miyajima estimates that the cost of generating electricity under the scheme worked out at 0.70 yen/10 ares, for 90 days of irrigation. Irrigation association costs added another 0.30 yen, so that total running costs came to about 1 yen per 10 ares. This compares with his estimate of approximately 13 yen/10 ares as the cost of labour for pumping under the old irrigation system (Miyajima,36,p.44). The farmers involved in the project whose accounts are considered later paid a little more

than this, 1.70 yen/10 ares, in pump running costs. But, at any rate, the reduction in the cost of raising water was very significant.

In addition the innovations freed family labour time, where this had been used for pumping. This meant that the limit to the area a family could cultivate with its own labour was increased, and was now set by the new peaks in labour use created by the change to unified late planting. These were at the times of transplanting and harvesting.

So the effect of the changes in technique was to reduce the costs of pumping and to increase the area a family labour force could cultivate before it needed to hire labour. This corresponds closely to the needs of the farmers in the one and two hectare categories in the hypothetical accounts, who were under pressure both to reduce wage costs and to produce more by farming larger areas. Now they no longer needed to hire labour to be able to irrigate and, apart from the very busy peaks at transplanting and harvesting times, family labour was freed to be applied to yield-increasing, labour-using techniques, or to cultivating a larger area.

As for the other types of farmer, the small-scale cultivator benefitted similarly from being able to use his family labour more intensively, but he gained less from the saving in hired labour costs, since these would not have been great for him before. Relief from the burden of having to work the treadle-wheels was an inestimable benefit to him, as to all cultivators. For the larger-scale farmer, mechanical irrigation was not a sufficiently labour-saving innovation to make it possible for him to continue to cultivate on a large scale. Even the middle-scale farmers still had to hire temporary labour at planting time, and the new limit to the size of the family farm was certainly below two hectares. So the pressures for the really large-scale cultivator to split up his holding were not reduced.

Those who benefitted most, therefore, from the introduction of mechanical irrigation and unified late planting were those who had already reached the limits of what their families could cultivate without hired help under the old technology, i.e. the middle-range, predominantly owner/tenant farmers who had either risen from the ranks of the small cultivators or declined from those of the large. But by what mechanism were they able to exert an influence on the timing and direction of technical change in order to achieve this?

The answer to this question will provide us with a link between the preceding structural changes and the present technical ones. To answer it we need to describe the way in which the introduction of mechanical irrigation was organised at the village level.

The authorities had recognised, as we have seen, that, if the pump was to be diffused at all widely, its introduction could best be organised communally at the village level. This arose from their recognition of the possibilities and limitations of two sets of factors. Firstly, although the motor was not large, it was too big for the requirements of the average farm. It was conceivable that richer farmers could have bought the pumps privately and hired them out to others, as happened with horses. But as the technically superior pumps were also static ones, this would not have been easy. The pumps needed to be installed over a wide area to make it worthwhile for the electricity company to build the supply facilities. When the authorities considered the scale of the pump in relation to the scale of the land holdings and capital assets of the majority of the farmers, they realised that widespread diffusion would depend on the extent to which the costs and use of the pumps could be shared among farmers.

But secondly, they were already faced with well-developed village organisations and a traditional communal approach. We saw in Chapter 3 how Saga villages were held together by the complex structure of economic and social relations, built round the hiring of land, labour and horses. The leaders of village society had come from the larger-scale, labour-employing, cultivator/landlord families who might be assumed to have acted in their own interests. But as long as they remained dependent on this village structure for their input supply and as long as their holdings were scattered around the village and dependent on a common irrigation system, part of that interest lay in the prosperity and security of the village as a whole. Although part of the economic basis of this communal system had disappeared, it was within this context that farmers had grown up and developed their approach to agriculture. Even today, the communal approach remains, and government agricultural policy still uses communal village-level organisations as a base.

Furthermore, it was through communal village organisations that the authorities had already built up their relationship with the villages. The co-operatives, agricultural societies and agricultural discussion groups, with the leaders of which the authorities consulted,

negotiated, carried out experiments and so on, almost always covered all the cultivators within the village. It was through them that the authorities had worked to spread new techniques, their leaders whom they had consulted about the development of the pump, and, naturally, to them that they turned when considering the widespread introduction of the pump.

Thus, on the one hand lay the economic necessity for widespread, shared diffusion of the pump, and on the other the well-developed village organisations and communal approach which the authorities were already using in their efforts to spread new techniques. The authorities put these facts together and proceded to work through communal village organisations, notably the irrigation associations, to diffuse the pump. Under the Oide scheme, we have seen that the Oide Association (the overall organisation of the irrigation associations of constituent villages) planned the siting of the pumps, organised the electricity supply and so on. The village associations were responsible for the installation of the pumps, the digging of the new water channels and the subsequent running of the pumps.

Perhaps most significantly, though, they were also resposible for the financing of the scheme in their villages. Within the Oide scheme, a large part of the cost of pump installation was met by loans from the Hypothec Bank of Japan (Nippon Kangyoo Ginkoo) (1). These loans were made to individual irrigation associations. The security for the loans and the responsibility for repayment was divided amongst the members of the association in proportion to the amount of land they cultivated. Thus the investment was made by the cultivators, not by landowners. Additional expenses and subsequent running costs were met by the members themselves, again in proportion to the area they cultivated. The irrigation associations which organised subsequent mechanical irrigation schemes outside the Oide Association's area were able, by calling their projects land

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(1) Before 1909, agricultural credit banks like the Hypothec Bank were run as private joint-stock banks and tended to make loans to landlords with good security, who did not always use them for agricultural purposes. After 1909, the government gave these banks funds to lend as unsecured loans to land improvement societies, co-operatives and other village organisations. See Katoo,63.

re-organisation schemes, to obtain government subsidies under the. Agricultural Land Re-adjustment Law, which had been ammended in 1923 to make subsidisation of irrigation projects easier. This meant that they bore less financial responsibility than the early innovators under the Oide scheme. For all projects, however, communal financing made it possible for the smaller and less credit-worthy farmers to take part in mechanical irrigation schemes. Without it, it is difficult to see how they could have found the finance or the organisational capability to adopt mechanical irrigation.

An example might give a clearer impression of the financial organisation of the scheme at village level. Yamada and Oota give figures for a mechanical irrigation scheme carried out in one village on the Plain and begun in 1923 (Yamada and Oota,46,p.341). It was organised, in the village, by a so-called Land Re-adjustment Association (Koochi Seiri Kumiai), to which all cultivators of paddy land belonged. The association was responsible for taking out loans and for meeting all the expenses of the project. In the first year it paid out a total of ¥57,000, the bulk (¥43,000) on construction expenses, the rest made up of administrative expenses and other extras, along with ¥3,000 running costs for the pumps. The large part of these expenses was met from a loan of ¥45,000 from the Hypothec Bank. The association also received subsidies from the prefectural and mura governments and from the gun agricultural society. The remaining ¥7,500 had to be supplied by members, who paid at the rate of ¥4.33 per 10 ares cultivated. In the second year (1924), there were more expenses to be met (some further construction costs, running costs of the pumps, interest on the loan) and no loans or subsidies,so the members had to meet these expenses at the rate of ¥7.70 per 10 ares. In subsequent years they began to repay the loan, and their contributions varied from year to year in the region of ¥5-10 per 10 ares.

Having seen how the projects were organised at the village level, we can now go on to look at the role played within this organisation by the middle-scale owner/tenant farmers who, as we have seen, appear to have had most to gain from such schemes. From the examples outlined below it is clear that it was farmers from this group who took the initiative in promoting the schemes and provided the leadership for them.

We can begin with an example given by Isobe (Isobe,76, p.36). The village in question, which was situated within Saga County,

had a land re-organisation (i.e. mechanical irrigation) association, and in May 1922 a tenants' association was also founded, with the aim, amongst other things, of supporting the land re-organisation association. The membership of the tenants' association consisted of 170 owner/tenant households and 98 tenant households. The relation of this to the whole village structure can be judged from the available figures for the composition of the same village in 1939, when there were 91 owner-farmer households, 143 owner/tenant and 105 tenant. In the month of its foundation (May 1922) the head of the tenants' association became head of the land re-organisation association and in September of that year he became village head. This gives some indication of the political rise of the owner/tenant group, and of how they were taking over the drive for mechanical irrigation.

The extent to which the middle-scale, owner/tenants provided the leadership of the mechanical irrigation movement can be seen in greater detail in two examples given by Yamada and Oota (Yamada and Oota,46,p.341 and pp.352-3). The first concerns the village whose finances were described earlier. Here, the officers of the association which organised the mechanical irrigation project numbered 14 and the areas of land they owned are set out in Table 5.1. The largest landowner owned 2.1 ha., 5 owned more than 1ha., and 5 owned less than ½ha.. The largest landowner in the area was an absentee landlord who owned 7.2 ha., but he took no part in the association at all. Thus there seems to have been no connection between large-scale landownership and influence over the mechanical irrigation project. The leaders were cultivators who, by and large, owned little land.

Details of the second example are set out in Table 5.2, which shows the land area cultivated and owned by officials of the irrigation association of Kuroihon village at the time of the introduction of mechanical irrigation. From this table we gain some idea of the balance of influence within the mechanical irrigation movement. The three special officials and the members of the construction committee were the leading organisers of the project. We can see that, for the most part, they were the larger cultivators in the village and did not rent in much land. These were the leading village households, who had been labour employers, according to Yamada and Oota. Almost all the other full-time farmers belonged to the consultative committee. They were smaller-scale cultivators and tended to be renting in more than the organising group. What is known

Table 5.1

OFFICERS OF THE LAND RE-ORGANISATION ASSOCIATION OF SAKAINO VILLAGE.

Position	Area Owned (ha)
Association Head	0.582
Deputy Association Head	0.212
Committee Member 1	2.120
" " 2	0.691
" " 3	1.350
" " 4	1.610
" " 5	1.840
" " 6	0.782
" " 7	0.702
" " 8	1.293
" " 9	0.491
" " 10	0.060
" " 11	0.003
" " 12	0.122

Source: Yamada and Oota, 46, p.341.

Table 5.2

THE PROMOTION OF MECHANICAL IRRIGATION IN KUROIHON VILLAGE.

A. Officers of the Irrigation Association.

	Area Cultivated (ha)	Area Owned (ha) 1919	1925	
Area Head Man	1.6-1.7	1.21	1.55	
Committee Member	Less than 1.0	0.40	0.40	
Assembly Member	1.2-1.3	1.49	1.80	
Construction Committee Member 1	1.7-1.8	1.71	1.32	
" 2	1.0	1.00	1.00	
" 3	1.0	1.00	1.19	
" 4	1.6-1.7	2.27	2.27	
" 5	1.7-1.8	0.12	2.02	
Consultative Committee Member 1	1.0	0.35	0.35	
" 2	1.0	-	0.43	
" 3	0.4-0.5	-	-	1934 Owned 0.11
" 4	0.6-0.7	-	-	1934 Owned 0.17
" 5	0.7-0.8	0.19	0.19	
" 6	1.2-1.3	0.14	0.14	
" 7	0.7	0.35	0.35	
" 8	1.3-1.4	-	1.47	
" 9	0.7	-	0.30	
" 10	0.8	-	0.14	
" 11	0.7	-	-	1934 Owned 0.12
" 12	0.7-0.8	-	1.30	
" 13	1.2-1.3	-	1.43	

/contd.

Table 5.2 (Continued)

B. Other Residents.

Cultivated Area (ha)	Nature of Side-employment				
0	Stone-Mason	Straw Weaver	Black-Smith	Nenko	Nenko
0-0.1	Factory Worker	Disabled	None	Nenko	Unknown
0.1-0.3	Nenko	Nenko	Unknown	Carrier	
0.3-0.5	Prefectural Employee	Straw Weaver	Straw Weaver	Straw Weaver	Carpenter
0.6	Specialist Farmer				
Unknown	Unclear	Unclear	Unclear		

Source: Yamada and Oota, 46, pp.352-3.

of the other residents of the village is indicated in the second part of the table. Altogether, we can see that the main promoters of the project were those households who were about at the limits of the area they could cultivate with their own family labour and who, as was argued earlier, stood to gain most from the investment. They were backed up by the smaller farmers who had more of the character of tenants and who also, as has been seen, stood to gain from the project, though their need was not so urgent as that of the somewhat larger-scale households.

To conclude this section the points made at the beginning need to be re-emphasised. Firstly, it is clear that the communal village organisation of mechanical irrigation projects played an important role in speeding up and widening the process of diffusion. It enabled smaller farmers to gain access to the pumps and to obtain the necessary finance. It made it possible, through the co-ordination of village organisations, under the Oide scheme, to introduce the pump over a wide area and to create the necessary infrastructure with speed and efficiency. It may have involved coercion of the smaller by the larger, but one cannot avoid the impression that the desire to be relieved of the labour of pumping water was so great that little persuasion would have been needed.

Secondly, the role of the middle-scale, owner or owner/tenant householders as innovators in the process has emerged clearly from the above examples. We saw earlier how they became economically the most powerful group within village society as a result of the structural impact of industrialisation. Now we have seen how they came to hold political power in the village and to control the village organisations which expressed the village's needs to the authorities. Furthermore, we have seen how the characteristics of the new technology met their needs quite well and how they provided the initiative and organisation at the village level for its introduction. Thus the impact of industrialisation has worked its way through to the technology of agriculture.

CHAPTER 6

The Development of a New Economic Structure, 1923-39.

We have now reached the stage at which a new innovation, pushed through by the initial innovator group (the middle-scale owner/tenants) who stood to gain most from it and whose problems most influenced its characteristics, had been diffused into the existing technical system. However, as we shall see in section 1 below, its introduction disrupted this system and caused a number of problems within it. This is the sort of situation which would generate Hayami and Ruttan's dynamic sequences of innovation and adaptation, and section 2 is concerned with looking at how these operated and how they were influenced by interaction between farmers and research and extension workers. We can then go on to see, in section 3, how the new technology itself influenced the economic and social situation of villages to create overall a new equilibrium within them. All this is to say that this chapter elucidates arrows 5 and 6 of the framework diagram.

1. The Immediate Impact of Mechanical Irrigation and Late Planting.

After the somewhat glowing account of the successful process of technical innovation in the last chapter we need to come down to earth to the realisation that mechanical irrigation and unified late planting disrupted the pattern of the old technology without of themselves affecting basic cultivation methods. This meant that there had to be further change, both to adapt the rest of the technology to the new rotation and irrigation method, and to realise the potential created by the reduction in the labour required for pumping. This section will describe the immediate impact of mechanical irrigation and late planting in order to show the areas in which pressure for change was created.

As expected, the mechanisation of irrigation achieved the desired reduction in the demand for labour at pumping time. Labour required for irrigation amounted to 7 days per 10 ares in 1909, whereas, by 1938, it had fallen to 2½ days (Isobe,76,p.10). The effects of this spread through to other aspects of labour utilisation.

Now that water was easily raised onto the fields, tokojime ploughing was no longer necessary. This further reduced labour requirements and made the specialised skills of the nenko redundant. Yamada and Oota regard this effect as being more important than the reduction of labour demand for pumping (Yamada and Oota,46,pp.357-364). This is because pumping could always be carried out by unskilled labourers or women and children, whereas ploughing necessitated the hiring of strong, skilled men. At any rate, the combined effect was to remove the need to hire labour on an annual basis. The phenomenon of the nenko disappeared almost immediately.

However, this did not mean that labour supply had ceased to be a problem or to place limits on the area a family could cultivate. Under the old rotation, the activities which had to be carried out at the busiest times of the farm year - planting and transplanting and the harvest - had been spread out over relatively long periods. With the new rotation, the spring/summer peak had been compressed from two months into one, and the effect of this on the pattern of labour use through the year can be seen in Table 6.1. This shows that, in the village surveyed, farmers had to put 5-6 times as much labour per 10 ares into rice cultivation during the June/July peak as they did in the slack periods of the year. Furthermore, rice harvesting combined with second-crop planting created another, slightly smaller, peak in total labour requirements around November/December.

These sharp variations in the intensity of labour use created both problems and potentials for Saga Plain farmers. In the first place, they meant that hired labour was still essential for many farms. The difference was that now it only needed to be hired for a relatively short period, basically for planting out the paddy field. The skills involved in transplanting were known to all rural dwellers, and women, young or old, could perform it as well as men. So instead of the skilled,permanent, strong male nenko, who had to be resident in the local area, it was now possible to manage with temporary workers from other areas where transplanting had already taken place and labour was consequently more available. Groups of workers, men and women, came over from villages on the other side of the river in Fukuoka Prefecture in a manner which became sufficiently established for them to be called Chikugo-san (Mr./Mrs. Chikugo), after the river they had crossed to reach the Saga Plain. So, although the nenko disappeared and labour-hiring ceased to be part of

Table 6.1

THE DISTRIBUTION OF LABOUR TIME THROUGHOUT THE YEAR IN A SAGA PLAIN VILLAGE, 1931.

(Units = hours per household)

	Total Labour Time	Labour Time in Rice Production	Labour Time in Rice Production per 10 ares
Jan.	475.3	203.8	11.1
Feb.	392.7	98.7	5.4
Mar.	430.9	89.7	4.9
Apr.	617.0	217.1	11.9
May	580.0	146.4	8.0
June	750.6	373.8	20.4
July	687.9	522.9	28.6
Aug.	461.1	195.6	10.7
Sep.	433.5	91.2	5.0
Oct.	457.6	130.2	7.1
Nov.	514.9	296.0	16.2
Dec.	546.4	145.1	7.9
Total	6,347.9	2,510.5	151.8

Source: Isobe, 76, p.37, from "A Survey of Labour Conditions in Farm Households in Saga Prefecture", covering 15 villages in the prefecture, and carried out in 1931 by the Saga Prefecture Industrial Society.

the complex of village inter-relationships, wages for hired workers remained quite a large proportion of total costs for medium- and larger-scale farmers. They reaped their benefits through greater ease in the recruitment and management of their hired labour forces by being able to tap a wider labour market. The pressure to try to reduce peak labour demands remained, though in a different form.

The second set of problems was created by the compression of the autumn peak in labour use under the new rotation. This meant that the length of time available for harvesting the whole rice crop and planting a second grain crop in time was very short. The wheat and barley seed varieties available would not mature in time for the seedlings to be able to survive the winter if they were planted even a little while late. Many farmers simply could not plant a second crop in time with the available labour supply, and this meant that double-cropping could not return to the levels it had reached before the rise in nenko wages.

A third result of mechanical irrigation and late planting was not so much a problem as the creation of a potential which could not be realised as things stood. The concentration of peak labour demand into two points had the corresponding effect of creating idle periods at other times. Saga farmers now found themselves at times distinctly under-employed. This, as we shall see, enabled them to find ways of intensifying their labour use both within rice cultivation and in other occupations. But it also relieved them somewhat from the pressures of the long growing season. Before, every job had had to be fitted precisely into the long sequence of activities. Now there was time to catch up if something were missed, and it seems that farmers never again had to work under the sort of pressure they had known before, so that they were able to take some of the gain from their increased labour productivity in the form of a less frantic pace of work.

The removal of the problem of pumping also brought to the fore other problems connected with the irrigation system. Although water could now be raised easily onto the fields, this did not solve all the problems connected with Saga's peculiar environment. Droughts, flooding, inadequate drainage and water control still stood in the way, at times and in places, of the kind of intensive farming which was now feasible in other respects. This meant that land which had previously been highly prized because of its low level, hence easy

pumping, now became less valuable than higher land which drained better. The need for improvement in other aspects of irrigation was thus intensified by the results of the solution to the pumping problem.

All these problems, though small in comparison with those already solved, needed to be dealt with before some kind of equilibrium between technology and economic organisation could be re-established. As a result, Chart 2.1 showed that there was no dramatic rise in yields immediately following 1923. It took a number of years more to adapt the technical system and produce the innovations necessary to exploit fully the potential created by mechanical irrigation and late planting, and the processes whereby this was done will be described in the next section.

2. Technical Change after 1923.

There were two directions in which farmers and researchers could move in order to solve the technical and organisational problems described above, and to use the potential of mechanical irrigation and late planting to raise incomes. On the one hand, ways could be discovered for making more intensive use of the family's more-or-less fixed factors: the family labour supply and the land it could cultivate without hiring extra labour. This involved, in effect, 'catching up' with the technical advances made elsewhere during the Meiji period, the essence of which involved raising the output of a given area of land by increasing inputs of previously idle family labour time and of variable capital (improved seeds, fertilisers, etc.). This would result in increased land productivity (yields) but not necessarily increased labour productivity in terms of output per labour hour or day.

The second possibility involved expanding the area of land which the family labour force could cultivate without hiring extra labour. Under the old technology, the limiting factor was the labour required for pumping. Now it was the labour requirements at the two most busy times in the early summer and in the autumn. It might prove possible to reduce labour requirements by smoothing out the peaks over a longer period of time. But the scope for this was limited by the necessity of planting rice after June 20th.. Beyond

this, labour requirements could only be reduced if some other factor (e.g. fixed capital) were substituted for labour at these times. This would result in an increase in labour productivity.

Both these courses were followed by Saga Plain farmers. This was made possible by the continued efforts of the research authorities, who followed up their success in mechanical irrigation and late planting with the development and diffusion of a series of less spectacular innovations. The reputation and the close contacts which they had built up with the farmers over the course of the earlier programmes helped them in this, as did the enthusiasm for change which the success of the earlier innovations had produced among the farmers. The two courses of change outlined above were closely linked, or involved identical developments at a number of points but, for the sake of clarity, they will be considered separately here.

(i) the intensification of land and labour use.

The essence of the so-called Meiji Noohoo (Meiji Agricultural Methods) involved a complementary set of improved techniques and new inputs: high-yielding seed varieties, commercial fertilisers, deep ploughing, more careful (labour intensive) cultivation methods like thinly-planted seed beds and check-row planting. As was described in Chapter 3, these methods did spread to the Saga Plain, but their adoption was somewhat haphazard as a result of conflicts between them and the old technology. Now, the methods of the Meiji Noohoo were quickly and successfully diffused throughout the Plain, as farmers and researchers set about exploiting the potential of the removal of these conflicts.

To begin with, the Experiment Station set about establishing which were the best rice seed varieties for the new conditions. The seed selection tests were completed in 1928 when the authorities announced that three varieties, Shinzan, Shintoku and Asahi No.1, had proved highest yielding and most suitable. By 1932 90% of the cultivated area of Saga County and Saga City was planted with improved varieties and so was 86.4% of the cultivated area of the prefecture (1). Shinzan had the most suitable characteristics for the Plain area. It was high-yielding, absorbed plenty of fertiliser, and did not produce very high quality rice. About 70% of the cultivated area of Saga

(1) Isobe, 76, Table 24, p.37, from a survey by the Experiment Station.

County was planted with Shinzan after its recommendation by the authorities (Miyajima,36,p.57). Thus from the situation which existed before the removal of the rice-borer problem, when a wide range of varieties (some improved, some not) had been planted, a complete change to the widespread planting of one or two improved varieties had taken place.

The new seeds were in large part better than the old because they would absorb more fertiliser. So along with the almost universal use of improved seeds went an increase in fertiliser input, largely in the form of higher inputs of commercial organic and, to some extent, chemical fertilisers. The data available for Saga County in the prefectural yearbook is presented in Table 6.2. Continuous series breaking down total fertiliser consumption into its components are not available, but it is clear that the most significant increases were in the use of commercial chemical fertilisers. The consumption of chemical fertilisers in Saga County increased from 1,543 tonnes in 1921 to 3,908 in 1929, and the use of compound fertilisers increased from 1,149 tonnes in 1930 to 6,156 in 1937 (SKTS,86). Isobe notes the connection between this increasing use of chemical fertilisers and the widespread diffusion of improved seed varieties (Isobe,76,p.36). All this implied sharp increases in the purchase of commercial inputs from outside the agricultural sector. (For data, see Appendix Table 8).

This process was assisted by the work of the research authorities. As a result of their experiments, they issued recommended fertiliser applications for every village and distributed them to each household. Farmers were trained in the use of fertiliser through fertiliser discussion groups and training courses run by the authorities, for which there was a huge demand (Miyajima,36,p.58). The authorities supplied fertiliser themselves and through co-operatives, and with it advice and instruction. In Chapter 3 we saw how improved cultivation techniques, which required greater labour input of a more precise and careful kind, were not always wholeheartedly applied on the Plain before the changes of 1922-3. Afterwards, however, they spread almost everywhere and thinly-planted seedlings, check-row planting and so on became standard techniques.

But perhaps the most significant shift towards more intensive cultivation occurred after 1927, when a short-soled plough suitable for heavy land was developed. This made deep-ploughing

Table 6.2

CONSUMPTION OF FERTILISER IN SAGA COUNTY.

	Quantity (tonnes)	Real Value* (1,000 yen)
1921	126,496	1,062
1922	127,229	1,016
1923	128,846	1,177
1924	133,772	1,006
1925	123,838	1,051
1926	134,674	1,229
1927	133,920	1,293
1928	130,173	1,269
1929	137,576	1,420
1930	138,652	1,462
1931	145,146	1,471
1932	147,155	1,302
1933	167,069	1,326
1934	162,520	1,452
1935	192,081	1,713
1936	182,847	1,599
1937	195,405	1,570

Source: SKTS, 86.

* Value of fertiliser consumed, from SKTS, 86, deflated by the fertiliser price index (1934-6 = 100) for the whole country given in LTES, 84, Table 19, column 6.

possible on the Saga Plain, and it spread rapidly. With this, and the fact that tokojime ploughing was no longer necessary, the whole process of land preparation could be greatly simplified. The three types of plough and the skilled ploughman became redundant. The horse was still essential, but the number of ploughings and the complexity of the operation could be greatly reduced. Furthermore, deep ploughing with the short-soled plough meant better absorption of fertiliser and was indeed a necessary condition for the success of heavy fertilisation.

Irrigation and drainage were not such severe problems now for those covered by the electric irrigation schemes. But for those who farmed in areas away from the central part of the Plain, some other form of energy was needed to drive irrigation pumps. Those at the extremities of the creeks, whatever form of irrigation they used, also found drainage difficult. In times of drought, water shortage could still be a problem everywhere. 1933, for instance, was a bad year because of drought. Furthermore, the best methods of cultivation involved raising and lowering the water level in the field at various points during the growing period. This also required good irrigation and drainage facilities. For all these reasons farmers began to buy petrol engines and vertical pumps, as primary or additional means of irrigation or drainage. The number of petrol engines in Saga Prefecture rose from 107 in 1923 to 13,483 in 1941, and that of privately-owned pumps from 721 in 1927 to 7,748 in 1941 (see Table 6.3). As a result of the spread of auxiliary irrigation facilities large areas avoided damage in the severe drought of 1939.

In these ways farmers were able to exploit the potential of currently available techniques to the full. But, as we have seen, the introduction of late planting and mechanical irrigation produced their own problems within the technical system, in the form of new peak labour demands which continued to make double-cropping difficult. These imbalances in the technology could not be solved with existing available techniques and led to the Saga research authorities' looking for new solutions to the problems.

With existing seed varieties, the rice crop which had been planted in June had to be harvested and threshed and the second grain crop planted within a very short space of time if the crops were not to be damaged. The same thing was true at the time of second crop harvesting and threshing and rice-planting. The Experiment

Table 6.3

NUMBERS OF AGRICULTURAL MACHINES, SAGA PREFECTURE.

	Petrol Engines	Pumps	Mechanical Threshers
1923	107		
1927	533	721	83
1931	867	792	86
1933	948	788	121
1935	1,516	1,279	151
1937	5,347		4,521
1939	7,860	5,112	7,289
1940	10,236		9,851
1941	13,483	7,748	

Source: Isobe, 76, Table 28, p.39, from a study of the diffusion of agricultural machinery in Saga Prefecture, made by the Saga Prefecture Agricultural Labour Research Institute in 1943.

Station therefore set to work to develop wheat and barley seed varieties which would mature in a shorter time. This involved not merely selecting varieties but also cross-breeding, and reveals the increasing levels of technical and scientific skill acquired by the research workers in the course of the 30 years' life of the Experiment Station. By 1935 a significantly improved variety had been developed. It matured more quickly with only a slight reduction in yields and was given the name Noorin 20. Cross-bred varieties of naked barley were also produced and these were named after Saga. These new seed varieties, combined with the improvements in irrigation and drainage resulting from the use of auxiliary pumps and motors, permitted the double-cropping rate to return to the levels it had reached before the labour outflow had set in.

These technical changes made it possible to raise yields, and hence output, by increasing the input of family labour time (by improved cultivation methods, double-cropping, etc.) and of current inputs (seeds and fertilisers). Their quantitative impact on yields was shown in Chart 2.1, but can be seen most dramatically in the village-level yield data assembled by Isobe from local surveys (Table 6.4). They show that throughout the 1910s and 1920s the majority of villages in normal years achieved yields in the range of 375-450 kg./10 ares, but that the early 1930s saw a shift in which nearly all villages rose into the 450-525 kg./10 ares category.

Before leaving this section we might also note some of the other ways in which Saga households increased the utilisation of their given family labour time. These trends became much more marked after the war but their beginning can be seen in the changes occurring after 1923. On the one hand, farm households began to diversify their agricultural activities. As far as their crops were concerned, they remained specialist grain producers, but they began to move into activities such as silk-production, horse-breeding and dairying, which required increased capital and family labour inputs but did not affect land utilisation. Before 1923 it had been a common practice to send work horses away into the hills to be looked after during the winter, because it was difficult to grow enough fodder crops for them. But now, with the revival of double-cropping, farmers began to keep the horses throughout the year and to grow fodder crops for them and breed from them. In 1925 78 horses were bred in Saga Prefecture, in 1936, 165 (Yamada and Oota,46,ch.9,section 3).

Table 6.4

VILLAGE-LEVEL DATA ON RICE YIELDS IN THE SAGA PLAIN AREA
(Numbers of villages obtaining given yields,
Plain areas of Saga-gun)

	kg./10 ares						
	225-300	300-375	375-450	450-525	525-600	600-675	Total
1912	4	14					18
1915		6	12				18
1916		4	13	1			18
1917		9	9				18
1918		10	8				18
1919		1	11	6			18
1920		1	13	4			18
1921		4	12	2			18
1922		5	12				17
1923			15	2			17
1924			11	6			17
1927		2	15				17
1928		8	8	1			17
1929		1	10	6			17
1930		1	13	3			17
1931		9	8				17
1932		2	11	4			17
1933			1	15	1		17
1934			2	14	1		17
1935		1	12	4			17
1936			8	8	1		17
1937			2	13	2		17
1938			1	12	4		17
1939			2	6	7	2	17

Source: Isobe, 76, p.6.

On the other hand, farmers were also diversifying into non-agricultural part-time occupations. During their relatively free winter times they began to do more straw-weaving work. More began to do part-time jobs away from home. By the present time a majority of Saga farmers are part-time farmers, earning more from non-agricultural work than from agricultural

(ii) mechanisation.

We can now turn to the other means of raising income which lay open to Saga farmers - expanding the area which the family labour force could cultivate. This meant, as we have seen, reducing peak labour demands, i.e. substituting some other input, more readily available, for labour at those times. With their experience of mechanical irrigation, farmers and research workers had already developed interest and expertise in mechanical agricultural methods. The increasing capacity and technical sophistication of Japanese industry was keeping down the relative cost of machinery. Further substitution of capital for labour seemed therefore the most likely method for dealing with the problem.

The most complete process of mechanisation which occurred was in the operation of threshing. Traditionally, threshing had been carried out using a simple wooden tool called a senba which was rather like a large comb on a trestle. Using it, between three and five people took a day to thresh the grain from ten ares. This labour was required at the spring and autumn peaks to thresh the two grain crops just when land preparation and planting were making their heaviest demands for labour. The first step towards the mechanisation of threshing was the development of a pedal-driven thresher which spread rapidly after about 1920. It reduced labour requirements to two men per ten ares worth of grain per day. But around 1931 there became available a mechanical thresher, driven by a petrol engine. The same engine could be used to drive a thresher and a drainage or irrigation pump and the increase in the number of mechanical threshers in Saga Prefecture from 83 in 1927 to 9,851 in 1940 was closely associated with the spread of privately-owned pumps (see Table 6.3). Mechanical threshers both for wheat and for rice were developed and with them six people could thresh the grain

from 50 ares in a day (1).

Weeding machines were also developed and diffused everywhere. Towards the end of the period hulling machines became available and were bought by larger-scale farmers or by groups. We have already noted the spread of individual motor-driven pumps. All these machines, but especially the threshers, reduced peak labour demands and by the time of the outbreak of war a family could manage 2 or even 3 hectares without hiring much temporary labour.

The Experiment Station played its part in this process too. It tested and experimented with the new machines which came on to the market in order to be able to advise farmers. From 1922 onwards it adopted the practice of holding open days at which farmers could see machinery and demonstrations and manufacturers could exhibit their new designs. In this way the research station continued to act as a co-ordinator between agricultural machinery manufacturers and farmers, just as it had done in the case of the irrigation pumps.

The changes described in this section are brought together in Fig. 6.1, which summarises the technology in operation on the Saga Plain in the 1930s. It represents the pioneering technology developed in Saga, as a result of which the '30s came to be known as the Saga stage (Saga Dankai) of Japanese agricultural development.

3. Changes in the Structure of the Farm Household Economy and the Village Community.

The technical changes described in the previous section, along with mechanical irrigation and late planting, combined to create what we shall call a new technology. It was not, of course, a complete, unchanging, equilibrium technical system, any more than was the initial technology described in Chapter 3. But it did represent, as it were, the stage achieved by the working through of the changes with which we have been concerned, before the process became confused by new and equally great upheavals. So, for our purposes, it can be regarded as the final outcome of those changes. In previous sections, we have

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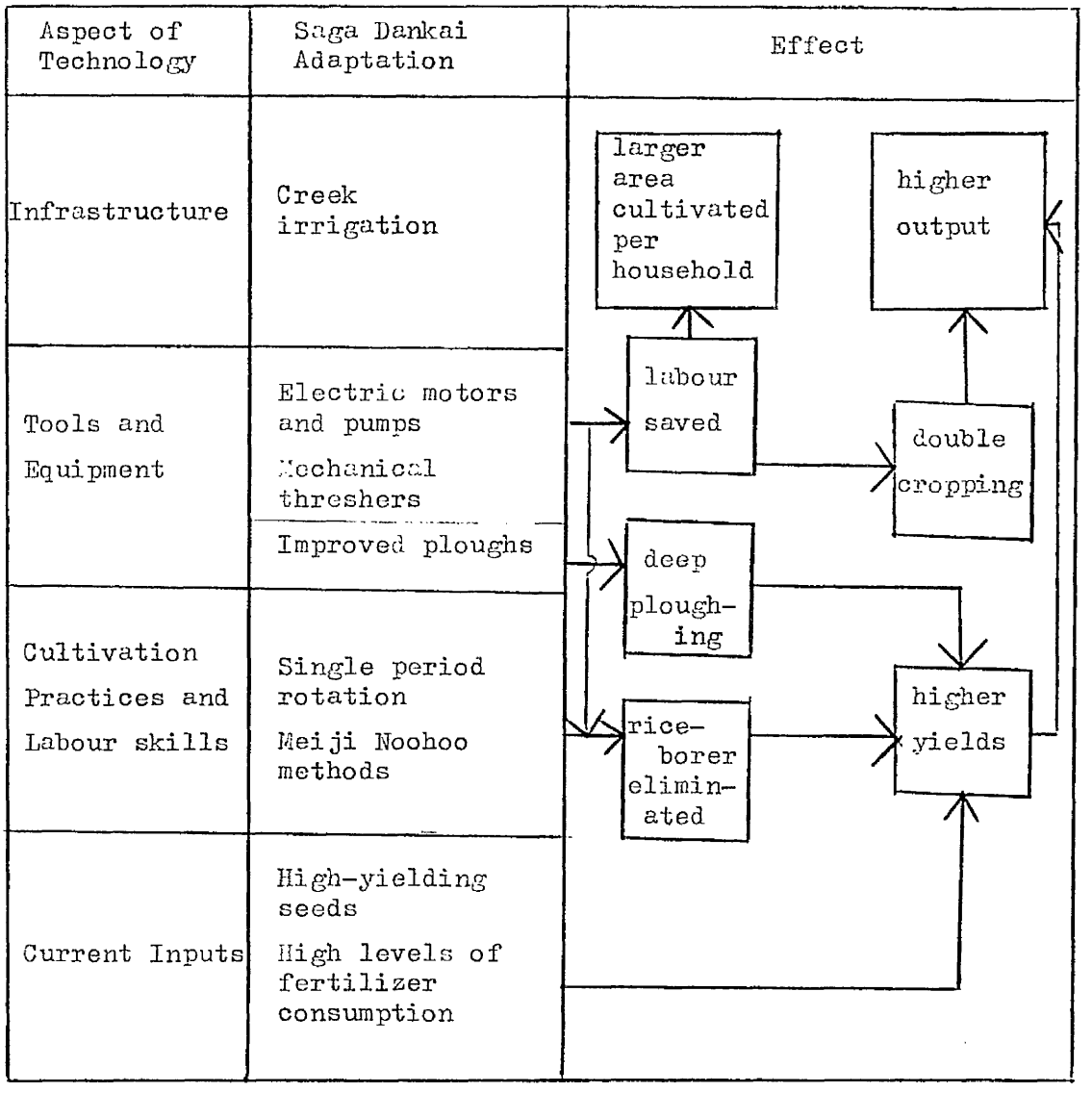
(1) See Eguchi, 33, from which the previous figures for labour requirements were also taken.

Fig. 6.1: The Saga Dankai (Saga Stage) Technology, showing how the aspects of the technology combined to raise output and to increase the area a household could farm.



looked at the ways in which changing agricultural organisation affected the direction and timing of the development towards this new technology. This section is concerned with the reverse relationship - the response of the village economy to the new technology, the ways in which the structure of the village economy and society adapted and changed. We shall begin by looking at the farm household economy operating the new technology and consider the new input/output relations of the farm unit, which would determine the differential impact of the new technology on different types of farm. We can then go on to look at changes in the communal village economy and at the effects of the new technology on the social and economic structure of the village.

(i) the farm household economy.

First let us consider the input patterns of farm households on the Saga Plain in this period.

i. Land. Table 6.5 shows the changes in the size structure of holdings in the period between 1922 and the war. Yamada and Oota have collected the figures for Saga County from a number of different sources, so that the trends are not very clear. However, the general tendency which stands out is the continued increase in the numbers farming middle-sized holdings. This is also clear in Chart 4.4 for the prefecture as a whole. The number of households in the two smallest categories continued to decline, although this trend does not appear very clearly in the county figures. There seem to have been increases in the proportion of households in all three categories between 1 and 5 hectares, and in the later years the number of households at the upper end of this range showed quite a marked increase. As the cases falling into the category of holdings above 5 hectares are few, the figures are somewhat erratic. But the very large landowner certainly seems to have continued to decline. In 1924 there were three landowners owning more than 50 hectares in Saga City and six in Saga County. By 1930 there remained only one in Saga City and three in the county. By the next year the last one in the city had also disappeared (1).

Table 6.6 shows the trends for one particular village in the latter half of the 1930s. Although we do not know into or out of

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(1) Isobe,76,p.43, using a national survey of landowners with more than 50 hectares, and SKTS,86.

Table 6.5

MOVEMENTS IN NUMBERS OF HOUSEHOLDS BY SIZE
OF HOLDING CULTIVATED
(Saga County, %)

	0-½ha	½-1ha	1-2ha	2-3ha	3-5ha	Over 5ha	Total
1920-4	20.9	25.8	35.4	14.1	2.6	0.1	100
1933	21.5	25.3	35.2	13.8	4.1	0.1	100
1934	21.0	25.5	33.8	14.8	4.6	0.3	100
1934-6	23.4	23.9	33.9	18.3	4.6	0.2	100
1940	18.7	18.7	36.2	20.0	5.5	0.1	100

Source: Yamada and Oota, 46, p.380.

Table 6.6

CHANGES IN THE DISTRIBUTION OF HOUSEHOLDS BY SIZE OF HOLDING IN A VILLAGE 4 KM. SOUTH OF SAGA CITY.

(Households)

	1934	1939
Over 3½ha	5	2
2½ to 3ha	1	3
2 to 2½ha	5	8
1½ to 2ha	11	7
1 to 1½ha	4	7
½ to 1ha	2	3
Under ½ha	8	6
Total	36	36

NB. During this period 4 households left the village and 4 new ones were established.

Source: Isobe, 78, p.133, from village records.

which categories new households were established or old ones left, the Table certainly suggests that households in this village were moving into the 2-3 hectare category from above and below it. The numbers of households at both extremes of the distribution were declining. The total picture therefore is one of continued concentration within the middle range of holding size, and within that range, of concentration at the upper end. Table 6.7 compares the stage reached in Saga in 1938 with that of the rest of the country. Again the same tendency for comparative concentration within the middle range, and especially towards the upper end of that range, is revealed for the Saga Plain.

A number of points arise from the picture made up by this data. Firstly, the division of village society into two more-or-less distinct groups - the larger-scale cultivating employer/landlord and the small-scale employee/cultivator groups - has disappeared. The majority of farmers now fall into the middle-scale categories. On average, no more than a quarter of households are outside the ½-3 hectare band. Thus differences in available land input per household have been much reduced and land, as a basis for wealth and status, has become much more evenly distributed. Of course, differences in income and status remained, but they were variations about one more-or-less standard type, the 1-3 hectare middle-range farmer. It is no longer possible to divide the village households into two distinct types as we did before. This change will be reflected in many other attributes of village society.

However, despite this trend towards the equalisation of holding size, the average area cultivated on the Saga Plain remained comparatively large. The proportion of households in Saga County farming more than a hectare, and especially of those farming 2-5 hectares, is well above the national average. The tables also provide evidence for the proposition that the upper limit to the area of the family farm was rising. Increasing proportions of Saga Plain households were falling into the 2-3 and 3-5 hectare size scales. The comparatively large and expanding size of the family farm on the Saga Plain is evidence of the relatively rapid rate of mechanisation there in relation to the rest of the country, and of relatively low labour input per hectare. This would lead us to expect output per man to be higher in Saga than elsewhere.

However, the ability to expand the area cultivated by the average farm depended on the availability of land. The data given

Table 6.7

DISTRIBUTION OF FARM HOUSEHOLDS BY AREA CULTIVATED

(1938, %)

	Whole Country	Saga Prefecture	Saga County
Under ½ha	33.9	24.1	21.7
½ to 1ha	34.9	33.8	25.0
1 to 2ha	22.6	32.8	34.6
2 to 3ha	5.7	7.8	14.2
3 to 5ha	2.3	1.4	4.4
Over 5ha	1.4	0.1	0.1

Source: SKTS, 86, and Kayoo, 83.

above compound two kinds of area within the Plain region - areas where newly-reclaimed land was available and areas where it was not. In the former the tendency towards concentration in the middle ranges was less marked. There was more emphasis on building up large farms and more scope for establishing new small farms. In the latter, the creation of large holdings or the establishment of new households was only possible to the extent that farmers were leaving agriculture, so that in these areas intensification of labour use within the middle ranges of the size distribution was more important (Isobe,78).

However, in areas where land reclamation was possible the nature of the projects carried out after 1923 provides further evidence for the importance of the initiative of the middle-scale farmer and of his desire to expand the area of the family farm under the impetus of the newly-available technology. In earlier times the pressure on the land and high rents had provided the main motives for land reclamation projects. But in the period after 1923 rents did not rise in line with increasing yields. The rental rate on the Plain probably declined from about 50% of the crop in 1923 to 35% in 1937 (see Table 6.8). Furthermore, the number of households was not increasing. The motive for land reclamation now lay in the middle-range farmer's desire to increase the size of his holding, and it was from such farmers that the initiative for projects in the 1920s and '30s came (Yamada and Oota,46,chapter 9, section 12). There was some tendency for the middle-sized farmers to lose financial control of the projects they had initiated, especially during the depression, so that they ended up renting rather than owning the new land. But their position remained strong as the large-scale owners of the land were weakened by falling rental rates and land prices and by the problem of finding tenants when the number of farm households was on the decline.

Through all the complexities of the land-use structure, however, one feature remains clear and can be re-emphasized. This is that, from the point of view of land holdings, the development of the new technology does indeed appear to have re-inforced the tendency towards concentration in the middle-size group and equalisation of holding size, which was set up by the labour exodus at the beginning of the century, by strengthening the economic position of the members of that group.

ii. Labour. The most marked change in labour use patterns after 1923 was, as previously noted, the almost complete disappearance

Table 6.8

RENTAL RATES IN SAGA COUNTY

(per 10 ares of middle-grade paddy)

	1909	1923	1937
Rents (kg)	180	193	193
Yields (kg)	370	375	549
Rental Rate (% of crop)	48.6	51.6	35.2

Source: Isobe, 76, p.42, from Saga Prefecture Government Report (1909), a survey by the prefectural interior department (1923), and a survey by the Hypothec Bank (1937).

of the nenko. This is evidenced by the changing structure of wage rates in Chart 4.3, where the effect of the decline in demand for annually-hired workers is revealed in the slower growth of their wages relative to those of daily workers in the '30s. After the introduction of mechanical irrigation, the average household was still hiring 450 hours of labour per year (Isobe,76,p.37), but it was temporary labour for the peak periods, from outside the village, and not the more-or-less permanent nenko labour. With the mechanisation of threshing and the improvement in rotations, the amount of labour hired continued to decline. With the spread of the power tiller after the war, the need for hired labour was even further reduced.

The changing structure of labour input shows how the progress of intensification of family labour use, combined with reduction in the amount of hired labour, was achieved. Table 6.9 is a condensation of data put together by Isobe to show changes in the labour input required by the various operations involved in rice cultivation. The reduction by about a half in the labour days required between 1857 and 1941 is concentrated in weeding and fertilising, irrigation and grain preparation. Comparing 1909 with 1938 or 1941, the impact of mechanical irrigation is obvious, but the effects of the mechanical thresher and the weeding machine can also be seen. Labour saved in all these operations reduces the summer and autumn labour demand peaks. On the other hand, labour input remained roughly constant and in places increased in seedling-raising and transplanting and in harvesting. This is the effect of improved methods of seed preparation, check-row planting and also of bigger harvests. Apart from harvesting, these were not operations for which there were narrow time limits and they offered scope for increased use of family labour. Thus the effect of the technology on labour input patterns also tended to strengthen the position of the medium-scale farmer.

iii. Capital. In previous sections, the growth in the ownership of machinery was described. These machines were added to the stock of buildings, tools, horses, cattle and so on already owned. Table 6.10 shows the distribution in 1937 of the ownership of the main items of mechanical equipment among households farming different-sized holdings and with differing tenancy status. Here we begin to see that, although inequality in the distribution of the use of land had declined, it had nonetheless been re-inforced by inequality in the ownership of capital assets. Small-scale farmers in general, and pure

Table 6.9

CHANGES IN THE COMPOSITION OF LABOUR USE
IN RICE CULTIVATION
(Saga Plain area, days per 10 ares)

	1857 Village A	1857 Village B	1888	1909	1938	1941
Land Preparation	6.72	3.56	4.50	3.80	3.72	2.30
Raising Seedlings	0.33		1.70	0.85	1.28	0.90
Transplanting	1.58	1.75	1.50	2.10	1.78	1.70
Weeding & Fertilising	10.00	6.50	8.00	8.50	3.67	4.30
Irrigation & Drainage	10.00	15.00	*	7.00	2.26	0.50
Harvesting	4.50	4.50	4.70	5.00	4.93	5.20
Preparation of Grain	6.87	6.00	4.80	2.00	1.05	0.60
Total	40.00	37.31	(25.20)	29.25	18.69	15.50

* probably about 7.

Source: Isobe, 76, p.10, from Yamada, 81, covering two villages in 1857; Survey of Agriculture in Saga Prefecture (1888), for Saga-gun; Saga Prefecture Government Report (1909), for Saga-gun; Survey of Conditions in Agricultural, Forestry and Fishing Villages (1938), covering 17 Plain villages; and the Imperial Agricultural Society's Survey of Agricultural Methods (1941), for Saga-gun.

Table 6.10

DISTRIBUTION OF THE OWNERSHIP OF MACHINERY
BY AREA CULTIVATED
(10 villages in Saga County, 1937, % of households)

A = petrol engine; B = mechanical thresher; C = pump.

	owners			owner/tenants			tenants		
	A	B	C	A	B	C	A	B	C
Under ½ha	1.5	0.0	1.5	1.7	0.9	0.9	1.1	0.7	0.9
½ to 1ha	3.2	2.0	2.2	5.8	4.0	3.1	3.3	2.4	2.1
1 to 2ha	19.4	17.9	12.4	20.0	15.9	11.6	13.2	10.0	9.3
2 to 3ha	50.6	47.7	32.6	46.5	42.1	29.6	29.5	26.5	21.0
3 to 5ha	75.0	71.5	52.3	78.9	71.6	56.2	52.4	48.8	33.3
Over 5ha	116.6	100.0	115.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Yamada and Oota, 46, Table IX.18, p.388.

tenant farmers in particular were far less likely to own any of the major pieces of capital equipment. Owners and owner/tenants, however, show much the same pattern. It is to be expected that small farmers would tend to use their family labour as intensively as possible rather than attempt to invest in larger-scale machinery. But it is interesting to note also that over 70% of owner and owner/tenant households in the 3-5 hectare category owned both petrol engines and mechanical threshers but that only about 50% of pure tenant households of the same scale did so. This unequal distribution of machinery appears as another source, besides varying holding size, of differential access to production inputs between farmers and within the middle range of the size-distribution. In part this was simply the result of the larger farmers' substitution of capital for labour and of the fact that the capacity of the machine was more than necessary for the small farmer, so that hiring the machine was more profitable. But, on the other hand, it also must have arisen from the inability of the smaller farmer, especially the tenant, to accumulate enough capital, and the reduced gains from mechanisation which a tenant could achieve. As we shall see when we come to look at the economic structure of the village, the necessity on the part of the lower-level middle-scale households of borrowing or hiring machinery created ties of dependence between households not unlike those which existed under the old technology.

We turn now from consideration of individual inputs to the structure of inputs, output and income as a whole within the farm household economy. As the wide divergence in available inputs between larger- and smaller-scale households had disappeared, we no longer need to describe the economies of two kinds of household. Instead the data to be examined concern the more-or-less typical middle-scale farmers. The economies of smaller or larger households would not have differed markedly from this pattern, except perhaps for some substitution of capital for labour by the larger-scale farmers, as was suggested earlier.

The data presented here, as Table 6.11, were assembled by Isobe from the results of the Rice Economy Survey carried out between 1913 and 1915 (as used previously) and the Middle-scale Farmers Survey of 1940. On the basis of preliminary surveys a number

Table 6.11

COMPARISON BETWEEN THE 1913-15 RICE ECONOMY SURVEY AND THE 1940 MIDDLE-SCALE FARMERS SURVEY FOR THE SAGA PLAIN AREA

(Income and expenditure expressed as proportions of income from rice)

	1913-15	1940
Number of Households	5	5
Income from Rice	100.0	100.0
Income from Second Crops	21.8	27.8
Income not from Cultivation	0.0	24.1
Total Income	121.8	151.9
Labour Expenses	25.8	50.8
Fertiliser Expenses	25.0	24.8
Rent	27.0	8.6
Taxes	9.5	4.6
Total Expenses	107.3	121.4
Net Profit	14.5	30.5

Source: Isobe, 76, Table 12.

of typical rice-producing households were selected for each area and made the subject of detailed surveys (1). The households selected for the Saga Plain for 1913-15 farmed 5.98, 2.00, 2.50, 2.00 and 2.60 ha. respectively. The figures shown are the averages for the three years. The Saga Plain households in the 1940 survey farmed 1.51, 1.92, 1.38, 1.95 and 1.80 hectares respectively. The averages for the two groups of households are shown in the table.

Table 6.11 is designed to give some idea of the change in the structure of the farm household economy resulting from the movement from the old to the new technology. On the income side the striking feature is the increase in the importance of income from sources other than rice production. Part of this is the result of double-cropping but part comes also from the expansion of other activities made possible by the freeing of labour time from rice cultivation. This is in effect what we have referred to as the intensification of family labour use.

On the expenditure side, the most interesting aspect is the increase in labour costs relative to income, both income from rice cultivation and, to a lesser extent, total income. This has occurred despite the adoption of an innovation which drastically reduced labour costs in one aspect of the technology. This suggests that it was not simply wage costs which provided the incentive to adopt mechanical irrigation, but also the change that it made possible in the type of labour employed. Labour availability was a problem as much as labour costs, and the value of mechanical irrigation lay not only in reducing labour costs below what they would otherwise have been, but also in making it possible to tap a much larger supply of labour in a geographically wider labour market. So the unskilled, migrant, transplanting labour force in the end took at least as large a share of the Saga Plain farmer's revenue as the nenko had done, but during the crucial period of the '20s and '30s, such labour was available,

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(1) The Rice Economy Survey selected households representative of large, middle and small scale farmers within each area. It is probable that there was some bias towards selection of households at the upper end of each size-scale. Since participation in the survey involved keeping careful accounts, the surveyors may have felt that better-off farmers were more likely to keep accurate books. See Oouchi,40.

while permanent, skilled, male nenko were not.

As for other costs, fertiliser expenses have remained proportionally about the same. The increasing input of purchased fertiliser was offset by its declining relative price, as Japanese industrialisation proceeded. Rent, on the other hand, has fallen dramatically as a proportion of income. This is the result of constant levels of rent in the face of rising yields, and reflects the increasing strength of tenants and difficulties experienced in renting out land.

The net result of the changes in income and expenditures is a clear rise in the proportion of its income which the average, middle-sized household could retain as profit, i.e. income for family members.

(ii) the village community.

i. Technology and changes in village social structure.

How did the change from the old to the new technology affect the social and economic relationships among households within the village? In this section we will consider how the coming of the new technology altered the relative economic and social statuses of households. In the next we shall look at its impact on economic relationships within the community.

Dr. Isobe, in his survey of the economic and social structure of a particular Saga Plain village in 1939, has collected a wealth of information on the question of the changing position of households within the village (Isobe,77). Table 6.12 presents some of this data. The households in the village are divided up into various categories. A, B and C are categories based on the ownership of capital equipment. The column labelled 'household type' categorises households according to their lineage relationship with other households. The households in the 'honke 1' group are the central families in the village. Most of the households in the 'bunke 1' and 'bunke 2' groups are branch households of the honke 1 families, that is, the land which the branch households farm was once part of the land of one of the honke 1 households. The original head of the branch household would have been a member of the main family's household (probably, but not necessarily, a relative of the head of the main household, e.g. a younger brother to the heir of the househead). Household 14 was not a traditional honke family, but had risen into the A category from

Table 6.12 (overleaf)

THE STRUCTURE OF A SAGA PLAIN VILLAGE IN 1939

Source: Isobe, 77, pp.222-3.

Notes:

(1) Asset ownership groups:

A = household owns horse, mechanical thresher, mechanical pump, mat-maker.

B = household owns horse, mat-maker.

C = household owns mat-maker.

(2) Honke = main household.
Bunke = branch household.
See Chapter 2, section II, 1, (i).

(3) O = owner, T = tenant, L = landlord.

(4) O = farm employing househead couple and their successor only.

(5) O = household where more than 60% of members are unable to work.

(6) Members of household employed off the farm:

⊙ = househead

O = successor

X = someone else.

(7) Double-cropping rate = planted area as a proportion of cultivated area.

Asset ownership group (1)	Household type (2)	Household number	No. of nonke & year estd.	Owner or tenant (3)	Area owned (ha)	Area farmed (ha)	1934-9 increase (O) or decrease (X) area owned	1934-9 increase (O) or decrease (X) area farmed	Labour structure (4)	(5) Dependency rate over 60%	Over 40 labour days per 10 ares	Nenko	Temporary labour (days)	Part-time in agriculture (males) (6)	Office Holding: Co-op director	Office Holding: Mayor	Office Holding: Deputy Mayor	Office Holding: Village council	Double-cropping rate over 150% (7)
A	Honke 1	1		T/O	1.52	3.50	X			O		2	17			1929-32	1895-11	1895-11	
		2		O/L	2.76	1.55	X	X					125		1908-13	1908-11	1911-14	1914-22	
		5		O/T	1.77	2.22	X	X		O						1911-14	1914-17	1922-26	O
		9		O/L	3.57	1.86	O	X			O				1908-15	1917-23			
		11		O/L	3.68	2.10	O	X		O			10		1914-15	1894-98	1904-08		
	Other 1	14		O/T	1.11	2.10	O	O								1914-17			
B	Honke 2	3		O/L	3.62	2.95		O	O				29		1908-13	1923-26			O
		4		O/T	2.22	2.50	X	O		O			21		1910-13	1902-08	1908-11		
		12		O/T	2.05	3.00	O	O		O		1	18				1902-04		
	Bunke 1	6	9,1921	O/T	1.45	2.21	O	O	O		O								O
		7	12,Mei	O/L	2.59	2.10	O	X		O			15						
		8	1,Mei	T/O	0.32	1.40	X	X											O
		10	5,Mei	O/T	2.06	2.71		X							1908-15	1926-29			
		15	9,Mei	O/T	1.40	2.04	O	O	O		O								O
		18	9,Mei	O	1.50	1.65		X	O		O			X		1935-38			O
		19	1,Mei	T/O	0.91	2.03	O	O	O		O			XX					O
		21	12,1906	O/L	2.53	1.50	O		O		O				1914-15	1932-35			
		22	5,1938	O	1.20	1.20					O								O
		25	14,1923	T/O	0.41	2.00	X	O	O		O		16						
	Other 2	13		O	1.29	1.12		X		O									O
		16		T/O	0.26	1.40		X	O		O								O
		17		T	0.01	1.50		X			O			O					O
		20		T/O	0.31	1.30		X		O	O		6						O
		23		O/T	0.92	1.75	X	X					2	⊙X					
		24		T/O	0.52	1.50		X			O		8	OXX					
		26	13,Mei	T/O	0.51	1.10	X	X		O	O								O
C	Bunke 2	27	2,Mei	L/O	2.00	0.20				O				⊙					
		28	11,1936	O	0.93	0.93					O								O
		29	2,1931	L/O	0.95	0.34	O	O		O			5	⊙					
		31	23,1937	O/T	0.35	0.85				O			85						
	Other 3	30		T		0.40	X	X											
		32	another village 1907	O/T	0.81	1.34				O			29						
		33		T		0.46							20	OX					
		36		T		0.62					O			X					
		37		T	0.02	0.20							11	OXX					
		39		T		0.45								OXX					O
		40		T	0.01	0.12								O					

being a tenant farmer. It was considered by the village to be a most remarkable family. Honke 2 households are similar to honke 1 households in not being branches of any other family, but only one has itself a branch household and they are probably declining households relative to the honke 1 group. Bunke 2 households, except for no. 27 which is the household of the village priest, are branch households established later than bunke 1 households and therefore of lower status and economic position. Households in the 'other 2' and 'other 3' categories have no particular relationships with other households in the village (apart from the inter-relationship between households 13 and 26).

Let us consider first differences in the inputs available to households in the various categories. Honke 1 households were traditionally leading village families and had previously been the nenko-employing households, farming 3 to 4 hectares in the Meiji period. This is borne out by the number and status of their branch households and by their importance in providing political office holders. The area these households now cultivated was, on the whole, not very different from that cultivated by the majority of bunke 1 and honke 2 households, but they still tended to own larger areas of land and retain their positions as landlords. They were, however, tending to reduce the area which they cultivated. The households of all honke families were larger, having more dependents than branch households, but they also tended to hire more labour. However, honke 1 households alone, apart from household 14, owned mechanical threshers and pumps.

Bunke 1 households farmed similar middle-sized areas to the honke households, but with no common tendency either to increase or reduce them. However, the typical structure of the bunke households contained only the househead couple with their successor and his wife and children. The households did not contain the dependent grandparents, brothers and sisters and other relatives which the traditional main households included, but it was the honke who owned the new agricultural machinery and the branch households had to borrow it from them.

'Other 2' households owned far less land than the other category B households, and they had more of the character of tenants. They were, without exception, reducing the area they cultivated and were showing the beginnings of a tendency towards becoming part-time

farmers with other non-agricultural employment. Much the same is true of all the households in category C, who, with their small, mostly rented holdings and their lack of capital equipment, had little to hold them in agriculture and were showing signs of beginning to move out.

From this it might be argued that it was the bunke 1 households who, from the point of view of available input supplies, were in the best position to maximise the income of household members by the use of the new technology. They had middle-sized holdings, compact family labour forces and access to machinery through their main households. Honke 1 households with their landlord characteristics, their rambling families and greater reliance on hired labour, do not look as though the objective of maximising income through intensive family labour was working as strongly on them, despite their ownership of capital equipment. The input structure of the old families, the outcome of long family histories, was not so well fitted to the task of making maximum use of the central family members' labour and of a middle-sized cultivated holding. They had income from the property they rented out and they had many household members amongst whom to spread the work. Isobe also points out that bunke 1 households were much more commercially orientated than were honke households.

We find this different emphasis reflected in variations in the techniques used by the two groups. Bunke 1 households nearly all applied more labour per hectare than honke households and had higher double-cropping rates. 'Other 2' households also had a tendency to farm more intensively than the honke households. But the households in category 3, like the big honke households, had neither the right input structure nor the incentive to use intensive methods. They were tenants, they had little land or machinery and their labour was more profitably employed off the farm. However intensively it was employed, it could not have substituted adequately for the land and capital assets which the household lacked. Thus, we can conclude that it was the input structure of the bunke 1 households which most closely met the requirements of the new technology and it was they who had adopted this technology most comprehensively.

Socially, the greater efficiency of the bunke 1 households with the new technology was reflected in their increasing political and social influence. With one exception, no member of a

honke household held any of the political offices examined in the table after 1926. The connection between the use of an increasingly mechanised technology and the rising influence of branch households and of younger men is a phenomenon which has been observed elsewhere in Japan (Kawamoto,64), and which became much more marked in Saga after the Second World War, the land reform and the introduction of the power tiller. The traditions and skills of the old families and the old men became obsolete as the old ways were replaced by mechanised and scientific methods, and the young learnt to operate the machines and thus became more influential. This process became more marked in Saga after the war but its beginnings lay in the changes which mechanical irrigation ushered in (1).

ii. Community economic relationships.

How did the shift from the old to the new technology and the resulting changes in social and economic status affect the economic relationships between households? We have already pointed out that the employment inter-relationships between households, which had characterised the old technology, disappeared after 1923, so that, from this point of view, households became more independent. But other features of the old community organisation remained despite the change in technology. Holdings remained scattered and overall land and water management remained a village responsibility requiring village organisation. Mud-raising continued to be organised by the community as a whole even after a machine was introduced to do it in the mid-1930s (2). Mutual assistance outside purely agricultural activities, such as assistance at weddings, funerals, childbirth, etc., and in tasks like thatching, as well as communal activities like road-repairing, were not affected by the disappearance of labour supply inter-relationships in production activities.

In addition there are some respects in which the new technology created inter-relationships to replace those which it destroyed. New agricultural organisations such as the agricultural societies, discussion groups and co-operatives were (and still are)

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(1) For a study of post-war social change in a Saga Plain village, see Yoshida, 75.

(2) Mud-raising machines were purchased by the village as a whole in the same way as the electric pumps had been. See Yoshida, 75, pp. 103-4.

organised at village level. The diffusion of new techniques through these organisations increased contacts between farmers and village-level solidarity. But in particular the new technology helped strengthen the village social structure through the role of groups in the purchase of machinery. The original pumps were bought by the village as a whole and the subsequent village organisation and maintenance added to the list of communally-run activities. The other major items of machinery (threshers, pumps, hullers, etc.) which were often owned, as we have seen, by the larger, main families, tended to be used in common by groups made up of a main family and its branch families (Yoshida,75,p.104). Alternatively, they were purchased jointly by neighbourhood groups. But at any rate, the traditional social groupings of the village were utilised to promote the spread of mechanisation and in this sense were strengthened by the new technology.

Isobe argues that these relationships generated conflicts which led to a dynamic process whereby the diffusion of improved technology was further encouraged (Isobe,77,pp.225-6). This resulted from the desire of the branch households to be free of their traditional dependence on the main families and from their consequent efforts to expand the size of their holdings and improve their financial positions in order to be able to acquire machines of their own. However, when Yoshida made his survey of a Saga Plain village between 1955 and 1960, he still found many honke/bunke and neighbourhood groups utilising machinery, including the post-war power tiller, in common.

Yoshida's survey also revealed how, at a much more general level, technical improvement and economic development on the Saga Plain helped to preserve the community relationships of the village. The whole combination of environmental and technical factors which generated relatively high family income levels in Saga Plain agriculture meant that the younger generations were encouraged to stay on the family farm and there was far less pressure to find work, either part-time or full-time, outside agriculture. The use of machinery added glamour to farming as a career and encouraged families to send their children to schools and colleges where they could acquire knowledge which would be useful to them in agriculture. Because agriculture was prosperous, there was less cause for the village community to break up. Thus, after the war, Yoshida found that

intra-village organisations, such as age-group societies, were much more active in the Plain village he studied than they were in the much more remote but agriculturally less productive and prosperous hill village with which he compared it (Yoshida,75,pp.110-15).

The conclusion to be drawn from this is that we should not assume that technical change, mechanisation and commercialisation necessarily lead to the break-up of community inter-relationships in the economic field. Although in some respects households became less inter-dependent, in others traditional community relationships were strengthened and new ones created as they were utilised to promote the introduction of new technology.

CHAPTER 7

Conclusions

The aim of this chapter is to bring together the major themes of the story of agricultural development on the Saga Plain and to assess their significance for our understanding of the process of technical change in agriculture in an industrialising country. Given that the process of technical change described was a successful one in terms of its ability to raise output in a particular environment, the main elements in the explanation of how this successful development was achieved can be brought together, in the context of the original framework, in order to see what can be learnt in general from the experience of the Saga Plain area.

That the process of technical change was a successful one has emerged from the micro data presented in earlier chapters, but is confirmed by the major economic indicators available for the area as a whole. Official data on output, inputs and factor productivities are assembled in Appendix Tables 6, 7 and 8. They show the steady increase in rice output and the substantial rise in yields and in labour productivity which resulted from the changes described earlier. These accompanied a slow increase in the cultivated area, a dramatic fall in the labour force, and substantial increases in material inputs, especially from outside the agricultural sector. From our point of view, the most interesting aspect of the picture is the speeding up of growth in the late '20s and early '30s. By about 1930, the new technology based on mechanical irrigation and late planting had taken shape and most of its problems and bottlenecks had been solved, or were in the process of solution. So the rapid rise in yields and labour productivity in the '30s can be seen as testimony to the impact on production efficiency of the new technology whose development has been described, to the speed with which it was diffused, and the success with which it was incorporated into the technical, economic and institutional environment so as to give rise to output growth.

The data also reveal the direction which this change took. The land-saving bias inherent in the general pattern of technical change in Japanese agriculture is apparent in the rise in yields, but more striking in the case of Saga is the labour-saving bias which

accompanied it. Increasing labour shortage must clearly have influenced this, and we can see that, in overall terms, Saga's experience bears out Hayami and Ruttan's hypothesis that relative factor scarcities induce certain directions of technical change.

However, the study has also shown that, at the micro level, the link between relative factor availabilities and the particular characteristics of innovations is not a straightforward one. The conclusions to which this gives rise can best be considered, in line with the original framework, under three headings or stages:

1. The initial conditions phase: the ways in which the economy, society and technology interacted before innovation took place and the influence of outside forces on these interactions.

2. The institutional mechanisms through which the direction of innovation was determined: i.e. the forces influencing the choice of technique to be developed, and

3. The phase of the interaction between the change in technology and the economic and institutional structure of the society.

1. The Initial Conditions Phase.

It was argued in Chapter 1 that it is useful to view agricultural societies in the initial conditions period as balanced systems in which technical, economic and social arrangements complement each other in attempting to make production and survival possible, within a given natural environment and historically-determined institutional conditions. This is borne out by what we know of the economic structure of Saga Plain villages in the latter half of the nineteenth century. The techniques chosen were the best available for making use of the given factor endowments, under the natural conditions of the area, to meet the objectives of village society. But we have seen that it was the economic and social arrangements between households (employment relationships, renting of land, borrowing of horses and equipment, etc.) which made the use of the techniques compatible with the initial structure of ownership of production factors.

In understanding how technical, social and economic systems interlock in traditional agricultural societies, the Saga Plain villages appear to bear out the idea that it is useful to view the choice of technique and of economic and social arrangements as heavily conditioned by the objective of minimising the risk of disaster and

attempting to ensure subsistence level survival for all village members. The normal risks involved in irrigated rice cultivation, of inadequate or excessive water supply, depending on rainfall conditions (which were, in any case, more severe in creek irrigation areas relying on river flow than in pond irrigation areas), were intensified in Saga's case by the high risk of insect pest damage. As we have seen, the technical system was adapted in many ways to try to spread out and lessen this risk. It played a large part in determining the rotation. It justified the use of a large number of different, low-quality, seed varieties, of dense planting of seedlings and so on. These practices almost certainly resulted in a sacrifice of output, both at the static level when the technical choice was determined, and in terms of ability to respond to opportunities to raise output. Yields on the early planted area were not as high as those on the late planted area, and some intervening planting date would have been better than either (Miyajima,36,p.22), so that the staggering of planting lowered overall output (although this is offset to the degree that labour shortage would have prevented the cultivation of such a large area without the parallel rotation). We have seen that Saga Plain farmers were not keen to adopt improved seed varieties or better cultivation practices which raised initial outlays and increased potential risk as well as potential output.

The technology developed was also conditioned by the problems of labour utilisation with the irrigation methods determined by the natural environment. This, combined with the idea of subsistence insurance, helps explain the non-market economic and social arrangements between households. Employment relationships between households on the one hand ensured the larger farmers the outside labour force on which their cultivation depended, and on the other hand assured poorer farmers of stable incomes and assistance, when needed, from their employers. This was backed up by other economic relationships - landlord/tenant ones and those based on the lending of horses and equipment, the granting of permission to use mud from the creeks, etc. - and by social arrangements - mutual help at difficult times, adopting children, arranging marriages, etc.. Thus the technical, economic and social systems balanced and complemented one another in making production feasible and attempting to ensure subsistence within the natural and institutional environment of the area.

A number of studies of peasant agricultural economies and

societies in countries other than Japan have found it illuminating to view the interlocking technical, economic and social arrangements of peasant communities in much the same way as is done here. Lipton, in his studies of Indian agriculture, has found it easier to explain a number of the practices and choices of Indian farmers in terms of the objective of maximising the family farm's chances of surviving than in terms of simple profit maximisation (Lipton,65). Scott assembles evidence to show that the principle of risk minimisation and subsistence insurance can be used to explain the attitudes and choices of peasant farmers in many parts of South-east Asia (Scott,28). The interest in these studies has generally been either in trying to find a rational explanation of failure to adopt new techniques, or in explaining the problems met by poorer farmers and agricultural workers as the system breaks down during the process of commercialisation. The study of Saga has shown that, to a certain extent, the economic and technical system based on subsistence insurance did inhibit the adoption of new methods and inputs. But in the crucial case of the pump it did not, neither did the poorer sections of society suffer from the commercialisation of agricultural production, and it is interesting to ask how this came about.

In part the answer must depend on the characteristics of the new technology, to the determination of which we will return later, but in part, I shall argue, it depends also on the village's relationship, in the initial conditions period, with the outside economy. The conditions under which Saga Plain farmers were drawn into the commercial economy were crucial in influencing not only the direction of technical change but also the effects of the adoption of that change on the structure of the economy and society.

The coming of commercial market relationships into the economic considerations of farm societies will tend to lead to the disruption of the traditional system which worked to try to ensure subsistence for all. In the case of the Saga Plain, farm households were drawn into market relationships with the outside world not only by the increasing demand for food output, but also by the increasing demand for labour. The traditional system was disrupted, not only by the increase in profitable opportunities for the sale of output, but also by the small farmer/agricultural labourer's finding his prospects sufficiently improved by the increase in employment opportunities to be able to opt out of the system which had assured him of a living,

but little more than a subsistence one. In other developing countries (though possibly excepting the cases of some now developed countries), this is not a typical way in which traditional rural economic systems are broken up and farmers drawn into commercial markets. More common causes of such changes would be such things as population growth, improvements in communications, impositions of taxes, changes in tenure and landownership systems, and the availability of new techniques itself.

Because the small-scale farmers had alternative employment opportunities, and because the resulting labour outflow improved the market bargaining position of those who remained in agriculture, they no longer had to rely on non-market arrangements for their security. With increasing income from the sale of output, increasing, as well as secure (as opposed to secure but stagnant) wage income, and with potential for increasing the land area cultivated by the household, the small-scale farmer could begin to consider experimenting with new techniques and with higher levels of commercial inputs. Because he consumed the same crop as he sold, however, increasing commercialisation did not require the Japanese farmer to risk his subsistence base. These factors, combined with the characteristics of the relevant technical changes and the institutional methods of their introduction, overcame any risk aversion on the part of the smaller-scale farmer.

The fact that the disruption and commercialisation of economic relationships to some degree benefitted the smaller farmer or agricultural labourer meant that it did not result in incentives for larger-scale farmers to abandon the tradtional insurance system from their side. Thus the hardships suffered by poorer farmers and landless labourers when traditional systems are broken up under other circumstances were avoided. So, not only the direction of technical change but also the social and economic effects of the adoption of that change were influenced by the availability of employment opportunities as a result of concurrent industrialisation.

2. Determining the Direction of Technical Change.

The usual practice when trying to explain the diffusion (or lack of it) of new technology (e.g. Green Revolution technology) in

agriculture is to assume a certain package of new techniques, whose characteristics are defined, and then to ask why farmers do or do not adopt the package. This is generally done by comparing the characteristics of the technology with such things as the availability and distribution of production factors, risk bearing ability, education and so on. At the other extreme is the study of the determinants of the overall direction of technical change in an economy or a sector, in terms of concepts like relative factor supplies and prices at the macro level. One of the objects of the present study has been to show that the institutional links between these two ends of the process, which determine the choice of the actual characteristics of the new techniques which become available to farmers, are of great importance in determining the success of the adoption and diffusion of the new technology. It is perhaps useful to begin by summarising what we know about these links in the case of the Saga Plain.

It is clear that the underlying pressure for technical change in Saga agriculture arose from the labour shortage brought about by the industrialisation of northern Kyuushuu. This gave rise to changes in the agricultural structure which disrupted the balance between it and the economic and technical systems in operation. The development of a solution to this problem, in the form of a mechanical irrigation method, was precipitated by the change in the relationship between wages and the price of rice which set in after 1920.

Thus the position of relative factor supplies in the regional economy worked its way through the economic and technical structure of Saga Plain agriculture to emerge as a demand for some means of saving labour in pumping irrigation water. But this by no means determined the actual form of the innovation. Choices still had to be made as to the size of the pump, its power source, its mobility and so on. These choices were made through the interaction between the farmers, the research authorities and the pump manufacturers, as they looked at pumps and motors already available and experimented with new designs. The result of this interaction was a pumping system which was the best that could be devised, within the constraints of existing technical knowledge, to deal with the farmers' problems within their natural and institutional environment. The authorities were then able to devise institutional adaptations to deal with the points at which the characteristics of the new technique clashed with the existing economic and social systems. So they were able to overcome

the problems of indivisibilities in the pumps themselves and in the supplying of electricity, and also to deal with the provision of credit, by using and adapting existing institutions and organisations. Thus, because there was feedback between the authorities and the farmers, it was possible to develop an innovation which, as far as possible, was easy to diffuse in existing economic and institutional conditions.

It is interesting to compare the development of this innovation with those of two rather similar technical changes in other countries. The first is the introduction of motor irrigation pumps in the Mekong Delta of Vietnam in the 1960s, as described by Sansom (Sansom,68). These pumps were adopted in order to be able to use water which collected in drainage canals to irrigate a second crop, and were technically somewhat different from the centrifugal ones used in Saga. They were driven by diesel rather than electric motors. They were less expensive than those in Saga but the role they played was very similar since, like the Saga ones, they were designed to replace pedal-driven water wheels. It is difficult to categorise this invention precisely in terms of its relation to relative factor supplies. Although it was the prohibitive costs of hired labour to meet the heavy labour requirements of water-wheel irrigation which prevented double-cropping before the introduction of the motor pump, yet the result of its use was an overall increase in labour input through the cultivation of a second crop. The invention was precipitated by a severe drought which intensified the need to be able to use the canal water.

The most striking difference between this and the introduction of mechanical irrigation in Saga is that, in the Vietnamese case, the authorities played no part at all. Although other kinds of pump were available, they were large and expensive, and a design suitable for widespread diffusion was developed by an individual farmer-cum-motor bike engineer. Knowledge of the pump spread by word of mouth and, since it cost no more than a pig, it was soon bought by many farmers. The result of its diffusion was a substantial rise in farm output and incomes. The authorities, both Vietnamese and their American advisers, played no part and were if anything opposed to the diffusion of the pump both on military grounds and because of its lack of engineering purity.

Sansom is concerned that the results of his study imply

that inventions emerge when the need for them is there ("necessity is the mother of invention") and that expenditure on research and extension activities contributes little to the process. The case of Saga would suggest that research authorities can play a constructive role in the generation of inventions by providing a link between farmers' needs for innovation and the supply of inventive ability and of advancing technical knowledge amongst scientists and industrial manufacturers. It suggests that the investment of resources in research and development of new techniques can yield results which are appropriate to farmers' needs, if the research is carried out within an institutional framework which makes scientists aware of the situations of farmers. This avoids reliance on the more haphazard processes of individual invention, which depend for successful development and diffusion, as Sansom points out, on the existence of a literate population, good communications and enough individuals with sufficient basic scientific knowledge.

Nevertheless, the institutions which condition the knowledge research and extension workers possess of farmers' needs and potentials are of critical importance, as is revealed by comparing Saga's experience with the introduction of the tubewell in the Kosi area of Bihar in India, as described by Clay (Clay,47). The disrupting influence in this case was simply the need to raise food output in India, which had reached a crisis-point in the mid-60s, when the decision to promote the introduction of tubewells on a large scale was taken. The requirement was for some means of raising food production quickly, and the promotion of credit-financed investment in relatively small-scale, privately owned tubewells, run by electricity, was seen as a way of achieving this. Thus, choice of technique and institutional arrangements was circumscribed initially by this decision taken at a national level, which ruled out, for instance, larger, publicly-owned tubewells or diesel-powered ones. The former would have been administratively much more difficult to organise, requiring communal regulation of cropping patterns. The decision to use electricity was possibly taken on the grounds of saving foreign exchange, but this is not clear.

The actual design and technical specifications of the tubewell to be used were decided at the state level and the supply of credit was tied to the use of this particular type of well, and also in theory to the use of a specified rotation of high-yielding seed

varieties. This package was meant to be used throughout Bihar (12 million cultivated hectares). Specifying it in this way clearly economised on administration and the use of skilled manpower.

However, from the point of view of the Kosi area, the technical choice made at the national and state level meant the use of wells and pumps which were larger, more durable and considerably more expensive than was necessary for the environmental conditions there. In most cases the pumps had spare capacity and arrangements for the trading of water were rarely possible because the necessary canal infrastructure did not exist. Furthermore, making scattered and haphazard electricity connections to those farmers who happened to be willing and able to take up the loans was expensive and slow, as was the installation of the wells. Very few of the farmers who bought tubewells used the prescribed rotation because, according to Clay, it involved higher risk and clashed with the existing cropping system and the economic organisation of the village based on it. Thus, despite the potential profitability of the use of tubewells, the actual programme was not a great success in promoting their installation or in raising food output.

It hardly needs pointing out that this process of rigidly specified technical choice from above, without feedback from those with knowledge of local conditions, resulted in the promotion of a technique which was not quickly adopted or easily diffused at the micro level. However, subsequent developments in the Kosi area suggest that the authorities did nevertheless play an important role in stimulating change. For the demonstration of the profitability of the tubewell idea, which the programme did achieve, led local entrepreneurs to try to adapt it to local conditions. They began to experiment with the use of bamboo pipes, with cheaper methods of boring the wells, with locally-made strainers, and with diesel motors which could be bolted on to bullock carts and thus used in several places and/or shared or hired out amongst farmers. These adaptations resulted in a much cheaper and more easily installed tubewell with less of an indivisibility problem. The number of installations of this kind of well rose dramatically and considerably exceeded those of the officially specified type of well. However, it took several years for the authorities to respond to these developments and change their programmes and precedures so as to be able to encourage the spread of the adapted type of well.

The lessons to be learnt from the comparison of this case

with that of Saga are thus not that the authorities have no role to play - it was they who introduced the idea of the tubewell to the Kosi area - but that failure to be aware of and responsive to local knowledge and initiative may slow up technical development in costly ways. In the Kosi case "the response of analysts and administrators alike is symptomatic of an insensitivity to feedback and an unwillingness to doubt the appropriateness of the package selected for the farmers." "The engineers were one powerful source of resistance to the implications of the feedback which was coming from the agricultural extension staff confronted with the problem of selling the package and aware of what farmers were actually doing." "The scale of the officially promoted package implied that farmers with fragmented holdings were somehow to adapt their farming to the technical specification of the irrigation equipment rather than vice-versa." (1)

In the case of Saga, on the other hand, the question of how the pump was to be diffused and utilised in the given local conditions was a crucial influence on the actual technical choice made by the authorities. They avoided the costs of investing resources in trying to diffuse a model which was difficult and slow for many farmers to acquire. They also spread out the fixed costs of making electricity connections by organising the communal installation of the pumps. Their incentive to do this was clearly heightened by their desire to establish late planting in order to destroy the rice-borer. But their success in inducing this change in rotations also contrasts sharply with the failure of the Indian authorities' attempts to use the introduction of the tubewell to spread changes in rotation. The consultation between the authorities and the farmers, the use of local organisations working through the structure of village society to persuade farmers right down to the individual household level, again contrasts strongly with the centralised procedures in the Indian case. Force on top of persuasion must not be forgotten in the Japanese case, but it is difficult to see how late planting could have been achieved without the consent of a large majority of farmers.

In general, this comparison between Saga and other cases suggests, firstly, that research authorities can play a valuable role in stimulating technical progress - this was so even in the Indian case. Secondly, it suggests that the speed and efficiency with which

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(1) All three quotations from Clay, 47, pp. 17-18.

research authorities are able to fulfil this role depends crucially on their contact with and responsiveness to local conditions and initiatives. Although initially this may involve higher administrative costs, it also avoids wasting resources on attempts to promote the spread of inappropriate techniques which fail to meet the authorities' objectives.

Underlying this, the basic reason why knowledge of and response to local conditions is important is that choice of technique involves decisions about a range of characteristics of a given technology considerably wider than simply its factor proportions. The more closely the chosen characteristics can fit into existing technical, economic and social systems, the more easily the technique will be diffused and the less effort will the research authorities have to spend, if they want to achieve speedy and widespread diffusion, on organising institutional arrangements to overcome the clashes between the new technology and the old systems. However, it might well be that the techniques which raise output most are those least able to be fitted into existing systems. So the authorities would be faced with a trade-off - the greater the output growth, the more must be spent on organising institutional changes. At any rate, what is clear is that, even if the overall direction of technical change in the economy is correct in reflecting relative factor scarcities, it is still important that research authorities, if they are to play a positive role in promoting and diffusing technical change in agriculture, are sufficiently knowledgeable about and responsive to local conditions to be able to develop and select the techniques whose overall collection of characteristics is as appropriate as possible.

3. The Social and Economic Effects of the Introduction of Technical Change.

I have argued that the initial diffusion of a new technique is determined by its characteristics relative to the social, economic and technical structure into which it is introduced. This latter controls factors such as the distribution of productive assets, access to credit, ability to bear risk, education, etc. which are often more specifically cited as determining the diffusion of new techniques. What has the case of Saga to teach us about the effects of

this first stage of adoption and diffusion of a new technique on the economy and society into which it is introduced?

Firstly, the experience of Saga clearly illustrates the idea of Hayami and Ruttan's dynamic sequences or Rosenberg's problem generation and solution process. The introduction of mechanical irrigation and late planting solved one set of problems but generated others through the potentials produced by the clash between new techniques and the old technical system. Hence the need arose to develop new seed varieties to solve the labour problems of double-cropping within the new rotation, for instance. In the Kosi case also, the initial introduction of the tubewell led to further technical development and adaptation as farmers and entrepreneurs responded to the potentials demonstrated by the new technique. The difference is that, in the Saga case, the research authorities played an active and positive role in this process, which the Indian authorities were slow to do. At any rate, Saga's experience bears out the idea that the introduction of a technical change can set in motion a dynamic process of its own, generating further technical innovations. Research authorities sufficiently aware of and responsive to farmers' needs can play a positive role in speeding up the production of the right kinds of innovation.

Secondly, what can Saga's experience tell us about the factors conditioning the effects on the economy and society of an area of the introduction of technical change? Many writers, observing the process of introduction and diffusion of technical change in agriculture in a number of areas of the Third World have concluded that it has tended to strengthen and intensify initial inequalities in the distribution of income and assets and, in some cases, to disrupt the social and economic organisation of villages, e.g. by leading to the creation of a class of landless wage labourers (1). It is concluded also that, very often, this is not determined by the characteristics of the new technology but by the effects of the initial social structure into which the change is introduced. This conclusion could be viewed as arising in part from inadequate characterisation of the technology, e.g. new seed varieties and fertiliser are divisible inputs, but they are technically highly complementary with an adequate and controlled supply of irrigation water which is not. Griffin suggests, for instance,

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(1) For an exposition of this view and much evidence, see Griffin, 8.

categorising technical changes as landlord- or peasant-biassed. At any rate, over-emphasis of the factor bias and scale economy or divisibility characteristics of technologies may conceal other characteristics which are also relevant to the diffusion of the technique.

But this is only part of the story. We must also look at the other side of the interaction - the social and economic structure into which the change is introduced, and the way in which it changes in response.

Data do not permit us to say what happened to the distribution of income in Saga, but we can infer much about the relative economic positions of different types of household from the information on land-ownership and the distribution of cultivated holdings. We have seen that the initial innovation was introduced into a structure in which middle-scale, owner/tenant farmers were becoming dominant. The position of smaller farmers was improving in some respects through the expansion of employment opportunities, and that of larger landowners and cultivators worsening as labour became scarcer. As we saw, this conditioned the direction of technical change through the interaction between farmers (whose leaders were now middle-scale owner/tenants) and research authorities in the process of technical choice. But the effect of the technical change itself was to strengthen the tendencies inherent in the initial situation, as reflected in the continued expansion of the middle-scale group, since it was this group who could profit most from the characteristics of the new technology.

There are two points arising out of the results of technical change in Saga, which are interesting in comparison with the picture painted of the effects of Green Revolution technical change today. Firstly, it would not appear that the process of technical change in Saga worsened the relative position of the smaller-scale farmer. This is partly, of course, the result of the expansion of non-agricultural employment opportunities, which were open to workers who became dissatisfied with their incomes in agriculture. But it is also true that the institutional organisation of the diffusion process was such as to overcome unavoidable indivisibilities and give all cultivators, regardless of scale, access to the most important innovation. The communal installation of the pumps and the collective organisation of the necessary credit were the factors permitting this. They were possible because of the nature of the initial conditions, the combination of forces making Japanese society what it was.

Nevertheless, it is possible that subsequently very small-scale farmers lagged behind in the adoption of further innovations and in general were unable to profit as much from technical development as the middle-scale farmer. This would appear to have been the case in the village discussed in the previous chapter. But it is also clear from that study that such farmers had other employment opportunities open to them and were taking them up, although some may have been slower than others in doing so.

Among the middle-scale households it would also appear that the ability to utilise the new technology was not completely equally distributed among households. Ownership of the major items of new equipment was concentrated amongst the somewhat larger-scale, older-established main households. But it was the somewhat smaller-scale, more compact, outward-looking and commercially-orientated branch households who were able to profit most from the new techniques. This clash between the distributions of asset ownership and economic power generated tensions as society adapted itself to the effects of the new technology. Thus technology played its part in the shift away from a social structure based on the old extended household to one based on compact, nuclear ones.

The second point arising from Saga's experience in this phase is related to this social change. In the Green Revolution case, it is often suggested that technical change, associated with increased commercialisation of agriculture, breaks down traditional social organisations and institutions (e.g. the kinds of communal insurance discussed earlier) and tends to lead to a polarisation of agricultural society into landowners and labourers. Although social change did accompany technical change in Saga, and traditional village organisations and functions did disappear, yet in some respects village cohesiveness and co-operation were strengthened relative to the situation in villages which had not seen comparable technical development in agriculture. Thus the fact that agriculture prospered on the Saga Plain, and that this increase in prosperity was felt by the whole village community, helped to strengthen the communal organisation of the village rather than put it under strains, such as increasing non-agricultural, part-time employment, or decline in the numbers of young people in the village, or increasing disparity in incomes. So the village society was able to continue to function as an aid to the diffusion of new technology, e.g. through group buying of machinery,

and this was still the case after the war. The organisation of the village community provided a certain continuity as a background against which the production techniques and household economies of member families shifted dramatically from those of subsistence producers to those of highly efficient, specialised commercial farmers.

Perhaps, ultimately, the only practical lesson that can really be learnt from the success of the Saga Plain area, or of Japan as a whole, in the development of agriculture, is that it depended on the discovery of the technology and the institutional framework which could best bring about growth within that particular environment. The story implies that there are no sets of pre-ordained characteristics of techniques or of institutions which will, of themselves, bring about rising standards of life. What was produced in Saga was a solution to its particular problems which reflected its own past experience and present aspirations. General theories, such as the induced technical change hypothesis, can help to explain the causes of events, but, at the micro level, success depends on understanding a particular environment and its history and developing new techniques whose characteristics are compatible with them and desirable in terms of the economic, social and political changes which their diffusion will surely, as the study has shown, bring in its train.

Appendix Table 1

RICE YIELDS IN SAGA, 1890 - 1935.

(5-yearly averages, kg/10 ares)

	Saga-gun	Saga-ken		Saga-gun	Saga-ken
1890	294.1	238.0	1913	351.4	329.2
1891	238.3	204.7	1914	360.2	333.4
1892	255.7	219.8	1915	368.6	339.2
1893	243.6	204.5	1916	352.0	328.8
1894	263.8	222.4	1917	368.9	327.9
1895	253.7	217.9	1918	377.6	335.6
1896	312.7	257.9	1919	376.3	328.9
1897	291.1	254.2	1920	379.7	330.2
1898	278.5	249.3	1921	390.3	362.4
1899	254.5	239.4	1922	387.5	366.9
1900	246.2	248.5	1923	386.3	362.5
1901	248.1	251.1	1924	393.3	370.3
1902	271.0	264.5	1925	401.4	373.6
1903	290.4	274.9	1926	395.1	339.8
1904	324.3	295.9	1927	396.7	340.6
1905	366.0	308.5	1928	395.2	341.6
1906	372.8	319.4	1929	383.9	332.8
1907	370.5	320.7	1930	383.5	333.0
1908	369.2	329.6	1931	402.9	353.7
1909	359.9	326.7	1932	411.7	360.1
1910	336.5	316.1	1933	415.4	362.0
1911	337.0	316.5	1934	431.2	378.1
1912	337.4	322.3	1935	444.3	389.8

Source: SKTS, 86.

Appendix Table 2

RICE SHIPPED OUT OF SAGA PREFECTURE, 1892 - 1935.

(5-yearly averages, tonnes)

1892	23,448	1914	70,246
1893	26,425	1915	78,718
1894	33,477	1916	85,174
1895	37,277	1917	97,086
1896	49,229	1918	84,498
1897	54,269	1919	91,001
1898	54,808	1920	82,492
1899	58,167	1921	79,184
1900	58,775	1922	74,455
1901	56,665	1923	77,997
1902	58,524	1924	69,190
1903	60,801	1925	75,489
1904	58,509	1926	73,920
1905	58,118	1937	73,471
1906	60,441	1928	76,754
1907	60,621	1929	83,437
1908	60,035	1930	80,820
1909	57,611	1931	84,495
1910	58,018	1932	93,844
1911	59,786	1933	94,395
1912	56,525	1934	90,947
1913	67,243	1935	95,465

Source: SKTS, 86.

Appendix Table 3

NUMBERS OF AGRICULTURAL WORKERS AND HOUSEHOLDS IN SAGA, 1890 - 1935

(5-yearly averages)

	Workers		Households			Workers		Households	
	Ken	Gun	Ken	Gun		Ken	Gun	Ken	Gun
1890	338.9	53.4	73.2	11.6	1913	272.2	38.0	69.6	10.7
1891	338.4	53.2	73.4	11.6	1914	269.5	35.8	70.4	10.4
1892	338.5	53.7	74.0	11.6	1915	262.9	32.1	70.5	10.1
1893	339.1	54.2	74.5	11.6	1916	258.2	32.3	70.7	9.9
1894	342.2	54.3	75.4	11.6	1917	250.1	32.3	70.8	9.8
1895	342.6	53.8	76.4	11.7	1918	247.3	31.0	70.8	9.6
1896	343.2	53.5	76.1	11.7	1919	239.3	30.4	69.5	9.6
1897	342.0	53.4	75.5	11.7	1920	234.6	29.5	69.1	9.5
1898	338.6	52.7	75.5	11.8	1921	230.2	28.4	68.9	9.4
1899	333.0	51.8	74.8	11.6	1922	225.1	27.3	68.6	9.3
1900	324.8	51.4	73.7	11.3	1923	220.8	26.7	68.5	9.2
1901	316.4	51.1	73.3	11.0	1924	219.1	26.4	68.4	9.2
1902	305.6	49.4	73.1	10.9	1925	217.0	26.5	68.4	9.3
1903	296.8	47.8	73.8	10.8	1926	215.7	26.9	68.3	9.3
1904	290.4	46.8	73.6	10.9	1927	215.0	27.4	68.3	9.3
1905	289.5	45.9	73.4	11.1	1928	214.4	27.7	68.4	9.4
1906	286.2	44.9	73.2	11.2	1929	213.0	27.9	68.5	9.4
1907	289.0	44.9	72.6	11.2	1930	211.8	27.7	68.4	9.3
1908	288.1	45.1	71.6	11.2	1931	109.9	27.5	67.0	9.3
1909	286.7	45.5	70.9	11.3	1932	208.4	27.4	66.7	9.3
1910	283.5	45.8	70.6	11.2	1933	206.8	27.5	66.4	9.4
1911	280.6	42,9	70.2	11.1	1934	205.3	27.5	66.1	9.4
1912	277.7	40.2	70.0	10.9	1935	203.9	27.5	65.8	9.4

Source: SKTS, 86.

Appendix Table 4

THE DISTRIBUTION OF HOUSEHOLDS BY AREA CULTIVATED

(Saga Prefecture, %)

	Under ½ha	½-1ha	1-2ha	2-3ha	3-5ha	Over 5ha
1908	35.8	35.0	18.2	8.3	1.2	0.4
1909	31.4	33.6	23.3	9.7	1.7	0.2
1910	36.0	34.9	18.3	8.3	2.1	0.3
1911	35.0	35.7	20.5	6.9	1.7	0.1
1912	32.8	38.3	21.2	6.2	1.9	0.1
1913	33.2	38.3	21.0	6.0	1.3	0.1
1914	33.1	38.0	21.3	6.0	1.4	0.1
1915	32.3	37.8	22.4	5.7	1.6	0.2
1916	33.0	37.8	21.5	5.9	1.6	0.1
1917	31.0	36.2	24.5	6.6	1.6	0.1
1918	30.6	36.6	24.4	6.5	1.6	0.1
1919	31.2	37.7	24.3	5.4	1.4	0.1
1920	31.8	35.7	24.8	5.9	1.7	0.05
1921	29.7	35.5	27.1	6.5	1.2	0.04
1922	27.5	35.0	29.7	6.4	1.0	0.04
1923	29.1	37.1	26.5	5.9	1.3	0.04
1924	29.3	37.2	26.6	5.7	1.1	0.01
1925	28.7	37.3	27.2	5.6	1.0	0.02
1926	27.5	36.8	28.3	6.2	1.1	0.04
1927	27.4	36.7	28.2	6.4	1.2	0.05
1928	27.3	37.1	27.9	6.5	1.1	0.06
1929	26.7	35.0	29.6	7.1	1.4	0.05
1930	26.0	35.3	30.3	7.0	1.4	0.03
1931	26.3	35.4	30.6	6.5	1.1	0.02
1932	25.6	34.3	32.6	6.6	1.2	0.05
1933	25.0	33.8	32.9	7.0	1.3	0.04
1934	24.4	34.2	32.8	7.2	1.4	0.06
1935	24.3	33.5	33.1	7.7	1.3	0.07
1936	24.1	33.8	32.8	7.8	1.4	0.05
1937	25.5	34.0	32.0	7.0	1.4	0.04
1938	25.5	32.2	32.9	7.8	1.4	0.04
1939	25.5	31.0	33.8	8.0	1.6	0.03
1940	25.9	30.9	33.3	8.2	1.6	0.06

Source: Kayoo, 83.

Appendix Table 5

DISTRIBUTION OF AGRICULTURAL HOUSEHOLDS BY STATUS

(Saga Prefecture, %)

	Owners	Owner/ Tenants	Tenants
1891	34.7	36.0	29.3
1895	32.5	44.8	22.7
1900	34.9	46.3	18.8
1905	33.4	44.3	22.3
1910	31.3	45.1	23.6
1915	31.1	46.3	22.6
1920	30.6	47.0	22.4
1925	30.3	47.2	22.5
1930	31.4	47.2	21.4
1935	29.0	50.7	20.3
1940	29.0	50.5	20.5

Source: Kayoo, 83.

Appendix Table 6

OUTPUT AND PRODUCTIVITY GROWTH IN SAGA.

(Indices of 5-yearly averages centring on years shown, 1888-92 = 100)

	Rice yields		Rice output		Rice output per worker	
	Saga-ken	Saga-gun	Saga-ken	Saga-gun	Saga-ken	Saga-gun
1890	100.0	100.0	100.0	100.0	100.0	100.0
1895	91.5	86.3	91.1	85.4	90.1	84.8
1900	104.4	83.7	105.8	83.1	110.3	86.3
1905	129.6	124.4	130.8	125.0	153.1	145.6
1910	132.8	114.4	135.5	116.5	162.0	135.9
1915	142.5	125.3	146.8	130.2	189.3	217.0
1920	138.7	129.1	147.1	133.1	212.5	240.7
1925	157.0	136.5	166.6	138.5	260.1	279.1
1930	139.9	130.4	152.1	135.6	243.5	261.4
1935	163.8	151.1	179.3	162.3	298.0	315.4

Source: Calculated from SKTS, 86.

Appendix Table 7

INPUTS AND FACTOR COMBINATIONS IN SAGA-KEN AND SAGA-GUN

(Indices of 5-yearly averages centring on year shown, 1888-92 = 100)

	Cultivated area		Agricultural workers		Land/labour ratio	
	Saga-ken	Saga-gun	Saga-ken	Saga-gun	Saga-ken	Saga-gun
1890	100.0	100.0	100.0	100.0	100.0	100.0
1895	101.8	97.9	101.1	100.7	100.5	97.4
1900	102.7	100.6	95.9	96.3	107.3	104.8
1905	103.0	100.7	85.4	85.8	120.5	118.8
1910	102.4	101.7	83.6	85.8	122.4	118.8
1915	103.3	102.7	77.6	60.0	133.2	171.5
1920	104.5	103.0	69.2	55.3	151.2	186.8
1925	106.3	101.6	64.0	49.6	165.8	205.3
1930	103.0	102.8	62.5	51.9	164.9	198.7
1935	103.8	105.9	60.1	51.5	172.7	206.1

Source: Calculated from SKTS, 86.

Appendix Table 8

CURRENT INPUTS IN SAGA PREFECTURE

(5-yearly averages centring on year shown,
1934-6 prices, million yen)

	Inputs of agricultural origin	Inputs of non-agricultural origin
1905-7	2.63	1.70
1910	2.70	2.68
1915	2.43	3.01
1920	2.42	2.83
1925	2.44	5.18
1930	2.54	6.33
1935	2.73	7.13

Source: Workbook for LTES, 87.

BIBLIOGRAPHY

A. Books in English.

1. BROWN, M., On the Theory and Measurement of Technical Change, Cambridge University Press, 1968.
2. BEARDSLEY, R., HALL, J. and WARD, R., Village Japan, University of Chicago Press, 1959.
3. DAVID, P., Technical Choice, Innovation and Economic Growth, Cambridge University Press, 1975.
4. DORE, R., Land Reform in Japan, Oxford University Press, 1967.
5. EMBREE, J., A Japanese Village - Suye Mura, Keegan Paul, London, 1946.
6. FUKUTAKE, T., Japanese Rural Society, Oxford University Press, 1967.
7. GRIFFIN, K., The Green Revolution, United Nations Research Institute for Social Development, Geneva, 1972.
8. GRIFFIN, K., The Political Economy of Agrarian Change, Macmillan, London, 1974.
9. HABAKKUK, H., American and British Technology in the Nineteenth Century, Cambridge University Press, 1962.
10. HAYAMI, Y., A Century of Agricultural Growth in Japan, University of Tokyo Press, 1975.
11. HAYAMI, Y. and RUTTAN, V., Agricultural Development - an International Perspective, John Hopkins Press, Baltimore and London, 1971.
12. ISHIKAWA, S., Economic Development in Asian Perspective, Kinokuniya Bookstore, Tokyo, 1967.
13. JAPAN ECONOMIC RESEARCH CENTER, Ed., Agriculture and Economic Development - Structural Re-adjustment in Asian Perspective, 2 vols., Japan Economic Research Center, Tokyo, 1972.
14. JAPAN - MINISTRY OF EDUCATION, Japan's Growth and Education, Tokyo, 1963.
15. KLEIN, L. and OHKAWA, K., Eds., Economic Growth: the Japanese Experience Since the Meiji Era, Richard D. Irwin, Inc., Homewood, Illinois, 1968.
16. LOCKWOOD, W., The Economic Development of Japan, 2nd. Edn., Princeton University Press, 1968.
17. LOCKWOOD, W., Ed., The State and Economic Enterprise in Japan, Princeton University Press, 1965.

18. NAKAMURA, J., Agricultural Production and the Economic Development of Japan, 1873-1922, Princeton University Press, 1966.

19. NAKANE, C., Kinship and Economic Organisation in Rural Japan, Athlone Press, London, 1967.

20. NASU, S., Aspects of Japanese Agriculture, Institute of Pacific Relations, New York, 1941.

21. OGURA, T., Agricultural Development in Modern Japan, Fuji Publishing Co., Tokyo, 1967.

22. OHKAWA, K., Differential Structure and Agriculture, Kinokuniya Bookstore, Tokyo, 1972.

23. OHKAWA, K. et al., The Growth Rate of the Japanese Economy Since 1878, Kinokuniya Bookstore, Tokyo, 1957.

24. OHKAWA, K., JOHNSTON, B. and KANEDA, H., eds., Agriculture and Economic Growth - Japan's Experience, University of Tokyo Press, 1970.

25. OHKAWA, K. and ROSOVSKY, H., Japanese Economic Growth, Stanford University Press, 1973.

26. REYNOLDS, L., Agriculture in Development Theory, Yale University Press, 1975.

27. SALTER, W., Productivity and Technical Change, Cambridge University Press, 1960.

28. SCOTT, J., The Moral Economy of the Peasant, Yale University Press, 1976.

29. SMITH, T.C., The Agrarian Origins of Modern Japan, Stanford University Press, 1959.

30. SOUTHWORTH, H. ed., Farm Mechanisation in East Asia, Agricultural Development Council, New York, 1972.

31. STEWART, F., Technology and Underdevelopment, Macmillan, London, 1977.

32. TSUCHIYA, K., Productivity and Technological Progress in Japanese Agriculture, University of Tokyo Press, 1976.

B. Books in Japanese

33. EGUCHI, M., Saga Noogyoo Oboegaki (Reminiscences of Saga Agriculture), 2 vols., Kinkadoo, Saga, 1971.

34. KAMAGATA, I., Saga Noogyoo no Tenkai Katei (The Development Process of Saga Agriculture), Noorinshoo Noogyoo Soogoo Kenkyuujo, Tokyo, 1946.

35. KYUUSHUU NOOSEI KYOKU, Saga Heiya ni Okeru Suiri Jigyoo no Enkaku (The Development of Irrigation Facilities on the Saga Plain), Fukuoka, 1967.

36. MIYAJIMA, S., Kome Tsukuri - sono Kunan no Ayumi (Rice Growing - a Story of Struggle), Akido, Tokyo, 1969.

37. NIHON NOOGYOO HATTATSU SHI CHOOSA KAI, (TOOBATA, S. and MORINAGA, S., Eds.), Nihon Noogyoo Hattatsu Shi (History of Japanese Agricultural Development), 9 vols., Chuuookooronsha, Tokyo, 1953-6.

38. NISHIMURA, H. and YOSHITOMI, N., Eds., Saga Keizai no Ayumi (Story of Saga's Economy), Saga Shookoo Kaigi Sho, 1966.

39. OOUCHI, T., Noogyoo Shi (History of Agriculture), Tooyoo Keizai Shinposha, Tokyo, 1960.

40. OOUCHI, T., Nooka Keizai (The Economy of Farm Households), Chuuoo Keizai Sha, Tokyo, 1957.

41. SAGA-KEN NOOCHI KAIKAKU SHI HENSAN IINKAI, Saga-ken Noochi Kaikaku Shi (History of Land Reform in Saga Prefecture), Saga, 1951.

42. TANAKA, S., Saga-ken Heitanbu Noogyoo Oyobi Nooson no Kenkyuu (Study of Agriculture and Agricultural Villages in the Plain Area of Saga Prefecture), Tooa Noogyoo Kenkyuujo, Tokyo, 1943.

43. TOOBATA, S., Noochi o Meguru Jinushi to Noomin (Landlords and Farmers in relation to Agricultural Land), Kantoosha, Tokyo, 1947.

44. TOOBATA, S., Ed., Shuuyoo Chitai Noogyoo Seisanryoku Keisei Shi (History of Agricultural Productivity Formation in Various Regions), Noogyoo Hattatsu Shi Choosa Kai, Tokyo, 1958.

45. TOOBATA, S., OHKAWA, K., and KAWANO, S., Eds., Nihon no Keizai to Noogyoo (Agriculture and the Japanese Economy), 2 vols., Iwanami, Tokyo, 1956.

46. YAMADA, T. and OOTA, M., Saga-ken Noogyoo Shi (History of Agriculture in Saga Prefecture), Saga, 1967.

C. Papers and Articles in English

47. CLAY, E., Planners' Preferences and Local Innovation in Tubewell Irrigation Technology in North-East India, Discussion Paper No. 40 of the Institute of Development Studies, University of Sussex, 1974.

48. DAVID, P., "The Mechanisation of Reaping in the Ante-Bellum Mid-West",

in David, 3, pp.195-232.

49. DAVID, P., "The Landscape and the Machine", in David, 3, pp.233-290.

50. DORE, R., "Agricultural Improvement in Japan", Economic Development and Cultural Change, Vol. 9, No. 1 (Part 2), October, 1960, pp. 69-91.

51. DORE, R., "The Meiji Landlord - Good or Bad?", Journal of Asian Studies, Vol. 18, No. 3, May 1959, pp. 343-355.

52. FALCON, W., "The Green Revolution - Generations of Problems", American Journal of Agricultural Economics, Vol. 52, No. 5, December 1970, pp. 698-710.

53. GOTSCH, C., "Technical Change and the Distribution of Income in Rural Areas", American Journal of Agricultural Economics, Vol. 54, No. 2, May 1972, pp. 326-341.

54. GRILLICHES, Z., "Hybrid Corn and the Economics of Innovation", Science, 29th July, 1960, pp. 275-280, reprinted in Rosenberg, N., ed., The Economics of Technological Change, Penguin Books, Harmondsworth, 1971, pp. 211-228.

55. HAYAMI, Y. and RUTTAN, V., "Korean Rice, Taiwan Rice and Japanese Agricultural Stagnation", Quarterly Journal of Economics, Vol. 84, No. 4, November 1970, pp. 562-589.

56. HAYAMI, Y. and YAMADA, S., "Technological Progress in Agriculture", in Klein and Ohkawa,15, pp. 135-161.

57. ISHIKAWA, S., "Technological Change in Agricultural Production and its Impact on Agrarian Structure", Keizai Kenkyuu, Vol 22, No. 2, April 1971, pp. 150-165.

58. ISHIKAWA, S., "Peasant Families and the Agrarian Community in the Process of Economic Development", in Reynolds,25.

59. ISHIKAWA, S. and OHKAWA, K., "Significance of Japan's Experience - Technological Changes in Agricultural Production and Changes in Agrarian Structure", in Japan Economic Research Center, ed., 13, pp. 141-197.

60. ISHINO, I., "Social and Technological Change in Rural Japan - Continuities and Discontinuities", in Smith, R.J. and Beardsley, R., Japanese Culture - its Development and Characteristics, Viking Fund, Chicago, 1962, pp. 100-112.

61. JOHNSTON, B., "The Japanese Model of Agricultural Development", in Ohkawa, Johnston and Kaneda, eds.,23, pp. 58-102.

62. JOHNSTON, B., "Agricultural Development and Economic Transformation - a Comparative Study of the Japanese Experience", Food Research Institute Studies, Vol. 3, No. 2, November 1962, pp. 223-276.

63. KATOO, Y., "Development of Long-term Agricultural Credit", in Ohkawa, Johnston and Kaneda, eds.,23, pp. 324-351.

64. KAWAMOTO, A., "Socio-cultural Adjustments of Farm Families and Rural Communities in the Process of Mechanisation", in Southworth,29, pp. 331-349.

65. LIPTON, M., "The Theory of the Optimising Peasant", Journal of Development Studies, Vol 4, No. 3, April 1968, pp. 327-351.

66. OHKAWA, K. and ROSOVSKY, H., "The Role of Agriculture in Modern Japanese Economic Development", Economic Development and Cultural Change, Vol. 9, No. 1 (Part 2), October 1960, pp. 43-67.

67. ROSENBERG, N., "The Direction of Technical Change - Inducement Mechanisms and Focusing Devices", Economic Development and Cultural Change, Vol. 18, No. 1, pp. 1-24.

68. SANSOM, R., "The Motor Pump - a Case Study of Innovation and Development", Oxford Economic Papers, Vol. 21, No. 1, March 1969, pp. 109-121.

69. SAWADA, S., "The Development of Rice Productivity in Japan - Pre-war Experience", in Japan Economic Research Center, ed., 13, pp. 115-140.

70. SAWADA, S., "Innovation in Japanese Agriculture, 1880-1935", in Lockwood, ed.,17, pp. 325-351.

71. SAWADA, S., "Technological Change in Japanese Agriculture", in Ohkawa, Johnston and Kaneda,23, pp. 136-154.

72. SIEGEL, B., "Social Structure, Social Change and Education in Rural Japan - a Case Study", in Spindler, G. ed., Education and Culture, Holt, Rinehart and Winston, New York, 1963, pp. 530-560.

73. SINHA, R., "Unresolved Issues in Japan's Early Economic Development", Scottish Journal of Political Economy,Vol. 16, No. 2, June 1969, pp. 109-151.

74. TUSSING, A., "The Labour Force in Meiji Economic Growth", in Ohkawa, Johnston and Kaneda,23, pp. 198-221.

75. YOSHIDA, T., "Integration and Change in Japanese Villages", American Anthropologist, Vol. 65, No. 1, February 1963,

pp. 102-116.

D. Papers and Articles in Japanese.

76. ISOBE, T., "Iwayuru Saga Dankai no Keisei Katei" (Formation of the so-called Saga Stage), in Toobata, ed.,43, Vol. 2, pp. 4-48.

77. ISOBE, T., "Saga Heitan Chitai" (The Saga Plain Region), in Isobe, H. ed., Kazoku Noogyoo no Henboo Katei (The Process of Change in the Management of Family Farms), Tokyo University Press, 1962, pp. 207-234.

78. ISOBE,T., "Saga Heitan Noogyoo ni okeru Kantakuchi Keisei no Kadai" (Land Reclamation in Saga Plain Agriculture), in Noorinshoo Noogyoo Soogoo Kenkyuujo, ed., Noogyoo Soogoo Kenkyuu, March 1961, pp. 127-164.

79. TANAKA, S., "Saga-ken Noogyoo Ron" (Agriculture of Saga Prefecture), Keizaigaku Kenkyuu, Vol. 9, No. 3, 1939.

80. WATAYA, T., "Shihonshugi no Hatten to Noomin no Kaisoo Bunka" (The Development of Capitalism and Rural Stratification), in Toobata, S. and Uno, K. eds., Nihon Shihonshugi to Noogyoo (Japanese Capitalism and Agriculture), Tokyo, 1959, pp. 191-257.

81. YAMADA, T., "Saga Heiya ni okeru Bakumatsuki no Nogyoo Gijitsu" (Agricultural Techniques on the Saga Plain at the end of the Tokugawa Period), Noogyoo Keizai Kenkyuu, Vol. 28, No. 1, 1956.

E. Statistics.

82. INABA, T. ed., (Fukkoku han) Nooka Keizai Choosa Hookoku - Choosa Hoohoo no Hensen to Ruinen Seiseki (The Farm Household Economy Survey Reports - their Methods and some Series from Them), Tokyo, 1953.

83. KAYOO, N., Nihon Noogyoo Kiso Tookei (Basic Statistics of Japanese Agriculture), Tokyo, 1958.

84. LTES = OHKAWA, K., SHINOHARA, M. and UMEMURA, M., Chooki Keizai Tookei (Long-term Economic Statistics), Vol. 9: Nooringyoo (Agriculture and Forestry), Tooyoo Keizai Shinposha, Tokyo, 1966.

85. NOOSHOOMU TOOKEIHYOO,later NOORINSHOO TOOKEIHYOO (Statisitcal Yearbook of the Ministry of Agriculture).

86. SKTS = SAGA-KEN TOOKEISHO (Saga Prefecture Statistical Yearbook)

87. WORKBOOK FOR LTES,84, available at Hitotsubashi Daigaku Keizai Kenkyuujo and called Noogyoo Keijoozaitoo Nyuugaku no Fukenbetsu Suikei, 1905-1940.